DENGUE AWARENESS

Cover Photo Credit: First Prize Winner of Dengue Awareness Drawing Competition & Exhibition (Go Jing Jie, SMK Kepong Ulu, KL)

UNIVERSITY OF MALAYA

UMR
University of Malaya Research

UM RESEARCH BULLETIN

Vol.19 No.2
2019

2019

Congratulations

UNIVERSITY OF MALAYA

Top 10 City-Centre
Most Sustainable Universities 2019

1st Asia's Most Sustainable University in City-Centre Setup (3 consecutive years: 2017-2019)

(Campus Setting Category)

University	Rank in City-Centre	Rank in the World	Overall Score (%)	Country:	Region:	Times Higher Education Ranking (2020)	QS World University Ranking (2020)	Times Higher Education University Impact Rankings on SDG
University of Oxford	1	2	90.00 %	United Kingdom	Europe	1	4	-
Leiden University	2	7	84.75 %	Netherlands	Europe	=67	118	-
Universita di Bologna	3	14	82.75 %	Italy	Europe	=168	=177	9
Universidad de Alcala	4	19	82.00 %	Spain	Europe	601-800	501-510	-
University of North Carolina Chapel Hill	5	21	84.75 %	USA	North America	54	90	24
Universiti Malaya	**6**	**34**	**79%**	**Malaysia**	**Asia**	**301-350**	**70**	**101-200**
Universita degli Studi di Torino	7	41	77.5 %	Italy	Europe	-	348	-
Universidade do Minho	8	55	75.75 %	Portugal	Europe	601-800	651-700	83
Universidad de Bogota Jorge Tadeo Lozano	9	61	75.25 %	Colombia	South America	-	-	-
University of Szeged	10	74	73.75%	Hungary	Europe	801-1000	501-510	101-200

PREFACE

As 2019 begin to draw its curtain, it is time to reflect on the happenings for UM again of the year. There has been many ups and downs for UM but through all these UM has been able to still fly the nation's flag high when it was ranked amongst the top 100 world university at the 70th position in the Quacquarelli Symonds (QS) World University Rankings® (QS WUR) 2020, up from the 87th place in 2019 QS WUR. In November, UM once again made history when it climbs to the 13th position in the QS Asia University Rankings, up from the 24th position we were placed at last year. Amongst the criteria that have helped UM achieve these positions in the QS university ranking is numbers of research publications and citation contributed by our researchers in UM. Thus, I would like to take this opportunity to thank our researchers for all their efforts and hope they will continue to contribute UM's success.

UM is very proud of the achievements of her researchers who are not only locally known but also of world prominence. Prof. Datuk Dr. Adeeba Kamaruzzaman did UM proud after she was elected as the president for the International AIDS Society and will take over helming the society in 2020. Prof. Ng Kwan Hoong, after receiving the prestigious Marie Sklodowska-Curie Award for his work in the field of medical physics in 2019 was named amongst the 100 Asian outstanding thinker and innovator by the Asian Scientist 100 (2019 edition). Prof. Ng was one of the only two Malaysian scientists who made it into this list, the other being Tan Sri Emeritus Prof. Zakri Abdul Hamid.

Closer to home, Prof. Fatimah Ibrahim and Assoc. Prof. Chong Wen Tong were awarded the Top Research Scientists Malaysia (TRSM) by the Akademi Sains Malaysia (Malaysian Academy of Sciences, ASM). At the conferment of award and fellowship of the ASM, seven researchers were made Fellow which carries the designation FASc after their names. They are Prof. Nik Meriam Sulaiman FASc, Prof. Yatimah Alias FASc, Prof. Sulaiman Wadi Harun FASc, Prof. Tan Kay Sin FASc, Prof. Wong Kum Thong FASc, Prof. Dato' Zainal Ariff Abdul Rahman FASc and Emeritus Prof. Masjuki Hassan FASc. Dr. Cheong Sok Ching FASc who is the Dr. Siti Hasmah Chair holder and associated with the Faculty of Dentistry, UM was also made fellow of ASM at the same event.

While our senior researchers are making names for themselves and UM, UM is equally proud for their young researchers too. Three teams lead by three young researchers from UM (below 35 years old) recently won the MY-RGS grant for young scientists following an intense pitching session to 12 esteemed judges on their research proposal and their potential impact.

The above are just some examples of the achievements of our researchers in 2019. There are many more which will take too long for me to describe here. We hope that 2020 will be equally kind to UM, if not giving us more opportunities to soar higher. Thank you and Happy New Year everyone.

Professor Dr. Noorsaadah Abd Rahman
Deputy Vice-Chancellor (Research & Innovation)

The end of 2019 marks the completion of the Malaysia Research Management and Governance (MRMG) Project of which UM, as the main collaborator for the Ministry of Education is proud to have set the pace for the implementation of important research processes.

Four areas covered by the project, namely professional research managers, open data, research impact and full economic costing, have all achieved significant milestones in their respective outcomes. The Malaysia Association of Research Managers and Administrators (MyRMA) was approved by the Registrar of Societies in July and had its first AGM on 23 September 2019 in conjunction with PECIPTA at UTHM, Batu Pahat. On 7 November 2019, the Malaysian Open Science Platform (MOSP) was launched by the Academy of Sciences Malaysia. Initiatives to set up a repository for research datasets which was a focus area in the MRMG project had been greatly instrumental in the establishment of MOSP. Research impact is a buzzword that has been receiving a lot of attention, and in UM we are moving towards narrative reporting for research impact and incorporating impact at the onset of proposal writing. UM new Impact Oriented Inter-discipline Research Grant (IIRG) emphasizes on engagement with stakeholders and identifying pathways to impact. Last but not least, we have been working out the full economic cost for research, and we hope to be able to demonstrate its importance in strategizing, optimizing resources, and ensuring financial sustainability.

Here's wishing everyone a great start to the coming year!

Professor Dr. Shaliza Ibrahim CEng FIChemE
Associate Vice-Chancellor (Research and Innovation)

EDITORIAL MESSAGE

Dear readers,

It is our pleasure to present the latest issue of UMR Bulletin (Volume 19, No. 2). Our goals are to create a platform for information exchange on all aspects related to research, covering the science and non-science research projects, as well as to encourage the dissemination of these knowledge to a broader audience. To achieve these, we strive to keep you updated on the current and continuous breakthroughs/contributions made by UM researchers, by giving you inside stories on their development and directions, plus introducing and highlighting our researchers and experts in each article.

Thus, we welcome you to submit original research write-ups with related images/photos of studies run by UM researchers. We hope that UMR Bulletin develops into a respected publication that is able to link external partners with our experts for any kinds of service or collaboration, that will ultimately enable us to transform our research into public consumption.

Our success entirely depends on your response. Thank you for providing us your continuous feedback and support.

Editorial team

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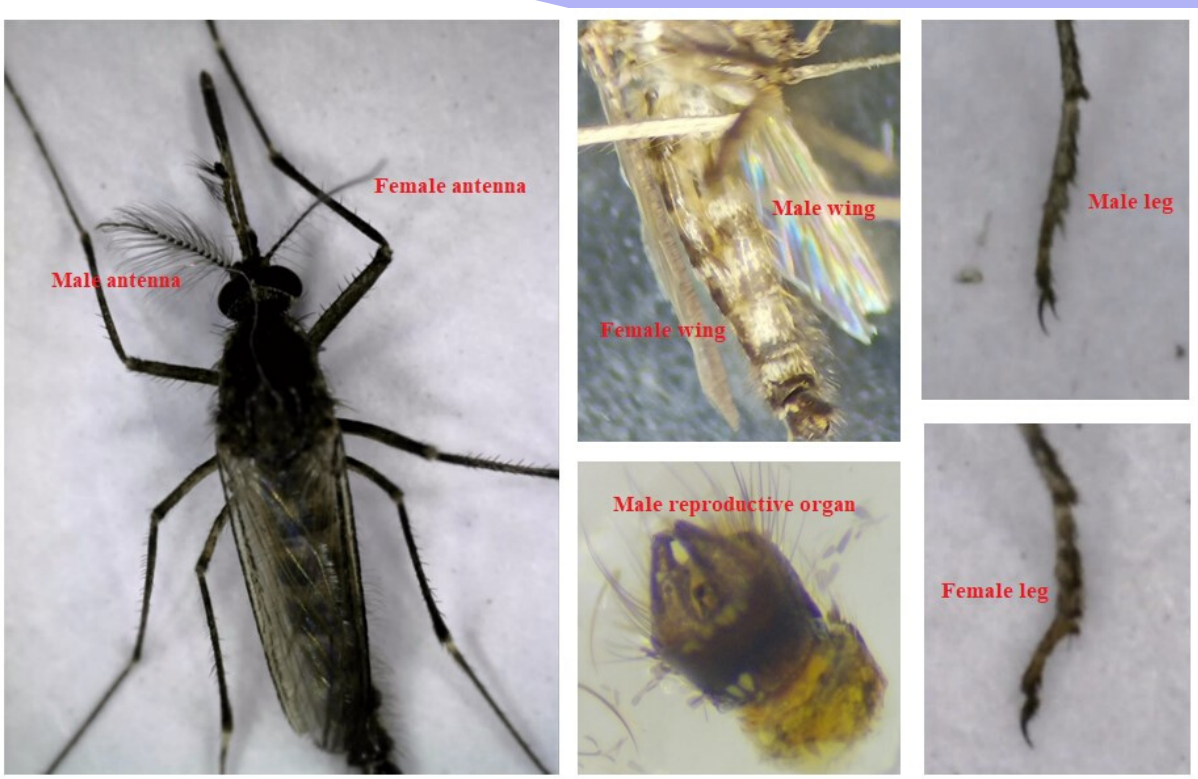
GENDER BEYOND MALE AND FEMALE: DISCOVERY OF AN INTERSEX MOSQUITO IN PAHANG, MALAYSIA

UM senior lecturer in vectors and vector-borne diseases Dr. Low Van Lun (left) showing samples of mosquitoes at UM's lab. Photo credit: Zulfadhli Zulkifli (NSTP)

The first "intersex" mosquito, known to be a vector for Japanese encephalitis, was found in Kuala Lipis, Pahang, recently. The intersex mosquito *Culex sitiens* was recently discovered by the UM researchers in a mosquito surveillance programme conducted in a rubber plantation area located at Kuala Lipis, Pahang, Malaysia on 20 July 2019. This is the first report of intersexualism or precisely 'gynandromorphism' for *Culex sitiens* worldwide.

This unique creature was attracted to a human during an *Anopheles* mosquito surveillance programme (human landing catch) and first gained attention by conspicuous irregularities of its head part—bushy antenna on the left side, the typical characteristic of a male mosquito. It was an unusual phenomenon because only female mosquitoes are attracted to human to obtain bloodmeal for egg production. This mosquito was then transported back to the laboratory for further examination.



An intersex of *Culex sitiens* discovered from Kuala Lipis, Pahang on July 20, 2019

Interestingly, intersexualism was observed in antennae, legs, and wings of the specimen, with distinct male characters on the left and female characters on the right. However, the mosquito displays well-developed male sex organ.

This species is native to various coastal areas because it uses salt and brackish water as its breeding habitats. The occurrence of this species is unexpected because the collection site, i.e.Kuala Lipis is an inland area at least 100 km apart from the east coast and west coast of Peninsular Malaysia. This observation merits further investigation.

Occurrences of intersexualism are often associated with the developmental processes such as double fertilization of a binucleate egg, loss of a sex chromosome, upregulation/downregulation of sex-determining genes; and causal factors such as mutations, genetic incompatibilities, temperatures, bacterial or parasitic infection.

Various mosquito control strategies have been introduced to reduce mosquito populations, including genetically modified mosquitoes. Although the release of genetically modified mosquitoes for disease control is still a good way off, this discovery may provide an opportunity for scientists to better understand the evolution and sexual development of mosquitoes, and to scrutinize the control potential by disrupting the sex determination pathway in mosquitoes.

This extraordinary finding was recently published in Acta Tropica, the Netherlands renowned journal for tropical medicine.

Media Coverage:

A press interview was published in https://www.nst.com.my/news/nation/2019/12/545629/first-intersex-mosquito-species-found-pahang

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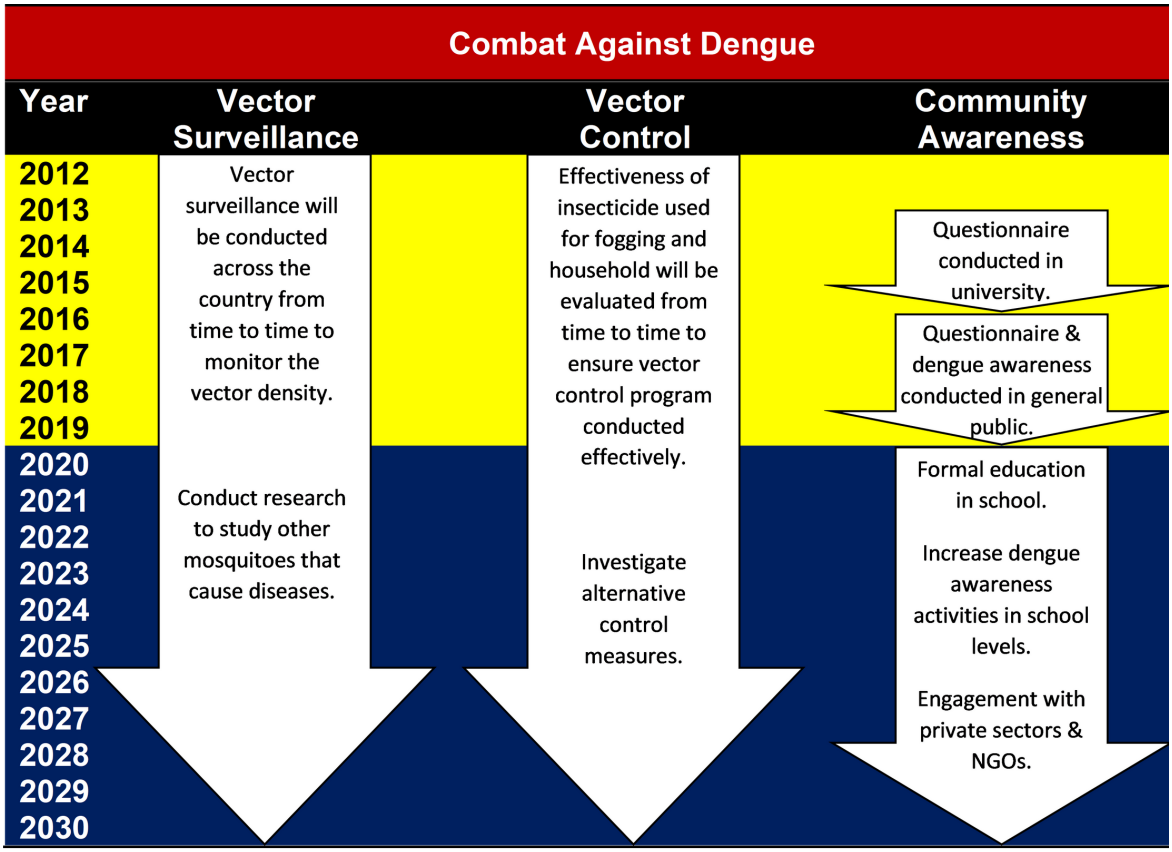
LEAVING NO ONE BEHIND: COMBAT AGAINST DENGUE



3 major components: (1) Vector surveillance, (2) Vector control; and (3) Community awareness to combat against dengue

The infectious diseases carried by mosquito vectors have been an increasing public health concern in recent decades. Dengue has been noted as the world's fastest-growing vector-borne disease with a 30-fold increment of cases and 764 Chikungunya cases were reported from January to November 2019. Both diseases are transmitted by *Aedes* mosquitoes, specifically *Ae. aegypti* and *Ae. albopictus*. Endemic peak of dengue and Chikungunya are thought to be caused by the escalating population of *Aedes* spp. Increase in *Aedes* mosquito population is largely contributed by massive urbanization and climate change, which create favourable breeding opportunities and conditions for mosquitoes.

Conducting surveillance studies beforehand is vital in carrying out effective vector control measures. Through these surveillance studies, improved understanding of *Aedes* mosquito dynamics can be achieved and better intervention measures introduced. In Malaysia, numerous surveillance studies had been conducted on the distribution of *Aedes* mosquitoes, but mostly centered in endemic and congested areas, such as Kuala Lumpur, Selangor and Penang. Four nationwide *Aedes* surveys were conducted in Peninsular Malaysia from 1971 to 1989. On the other hand, *Aedes* surveillance in Sabah and Sarawak had been carried out almost 40 years ago and was outdated. Knowledge of *Aedes* distribution in different environments needs to be ascertained. The surveillance remains the preliminary step used in vector monitoring and control.

Chemical insecticides are conventionally used to control *Aedes* in most of the world. However, concerns over the environmental

consequences, the resulting legal constraints regarding the development of insecticides resistance by target species have brought about intensified efforts to monitor the susceptibility status of targeted species towards conventional insecticides. Several surveys have shown that insecticide resistance was observed in mosquitoes, more than 100 mosquito species have developed insecticide resistance against various classes of insecticides, including *Aedes*.

For many years, resistance was detected in an insect population only when it had evolved to the point where it had no obvious impact on a control program. The early detection and monitoring of resistance are recognized as a vital part of resistance management. Resistance management is an area of research that is directed at developing insecticide usage strategies that minimize the rate of evolution of resistance.

Today, resistance management in the context of integrated vector management has evolved as the favoured approach to prevent, delay or reduce the impact of insecticide resistance. To fully develop this strategy, a thorough knowledge of the mechanism of insecticide resistance is essential. Evaluation of potential alternative control agents such as biopesticides, insect growth regulators (IGRs) and synergists to replace the usage of insecticides is needed to minimize the development of resistance.

Dengue treatment plan only includes monitoring of vital parameters like platelet count and blood pressure, since an effective and safe tetravalent vaccine has not been developed to counter this disease. Therefore, vector control is still considered the most important strategy in dengue prevention plan. In Malaysia, under the Vector-borne Disease Control Program in the Sixth Malaysia Plan, four control strategies have been gazetted, which include anti-larval measures, anti-adult measures, health education and enforcement of the Destruction of Disease Bearing Insects Act (DDBIA) 1975.

The increasing incidence of dengue and its more severe forms calls attention to the importance of health, behaviours and attitudes toward the prevention of dengue, which may be enhanced by studies addressing the knowledge, attitude and practices related to dengue and its vector. However, the knowledge on this topic was not educated to our young generations and communities via formal education in school (primary and secondary).

The project consists of 3 major components: **i) Vector Surveillance** - The information obtained from the surveillance is important in determining the vector density, larval habitats, distribution of the mosquitoes and could be used qualitatively and quantitatively to predict the occurrence of disease outbreaks, as well as carried out effective control measures to suppress the vector populations; **ii) Vector Control** - Since an effective and safe tetravalent vaccine has not been developed to counter dengue, thus vector control is still considered the most important strategy in dengue prevention plan; and **iii) Community Awareness** - Health education and legislation enforcement are also crucial to intensify knowledge, create awareness and steer behavioural change of general public in combating the dispersal of dengue vectors.

By covering all the 3 major components mentioned above, it able to directly educate the public on dengue and thus reducing the risk of dengue transmission to the communities.

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BLOOD DONATION: MOTIVATION AND DILEMMA

Blood donation in Malaysia

Four to five hundred units of **blood** are needed in a day.

One unit is about 450ml of **blood**.

One **blood** donation

Blood is precious for those who involved in serious accidents and/or those have health issues due to routine surgeries or for treating a serious disease like thalassemia or cancer. The present trend blood collection and capacity usage in Malaysia have raised concerns about the availability of this product to meets its current needs. The study showed that the blood reserve is usually below than what is targeted because the biggest challenge is to get a good number of Malaysian to donate blood. Similar to other countries, Malaysia relies on a small number of volunteer donors, whereby the number of blood demand is not equal with the number of blood product supply. Although Malaysia has more than 30 million population, the study found that only 2.2 per cent of the population is willing to become a volunteer blood donor.

Malaysia government has initiated many approaches to encourage voluntary blood donations by its citizens. These efforts include intensive advertisements via mainstream and social media, providing mobile blood transfusion units and donation suites, offering incentives for blood donors (Table 1) and promoting blood donation via collaborations with other government institutions and agencies. Despite these initiatives, Malaysia is still unable to meet the demand for blood product availability.

Table 1: Incentives for blood donors

Donation frequency	Treatment benefit
1 time	Free outpatient treatment and medical treatment (excluding x-ray and operation payment) and second-class ward for 4 months
2 times (within 12 months)	Free Hepatitis B injection
2 to 5 times	Free outpatient treatment and medical treatment and second-class ward for 4 months
6 to 10 times	Free outpatient treatment for 1 year and medical treatment and second-class ward for 6 months
11 – 15 times	Free outpatient treatment for 2 year and medical treatment and second-class ward for 1 year
16 – 20 times	Free outpatient treatment and medical treatment and second-class ward for 2 years
21 – 30 times	Free outpatient treatment and medical treatment and second-class ward for 3 years
31 – 40 times	Free outpatient treatment and medical treatment and first-class ward for 4 years
41 – 50 times	Free outpatient treatment and medical treatment and first-class ward for 6 years
More than 50 times (for Whole Blood donors) and more than 150 time (for apheresis donors)	Free outpatient treatment and medical treatment and first-class ward for 10 years and eligible to receive second class ward for entire life after ending the 10 years of first-class ward term

There several factors why Malaysian are still not keen to be a blood donor: Among the reasons are:

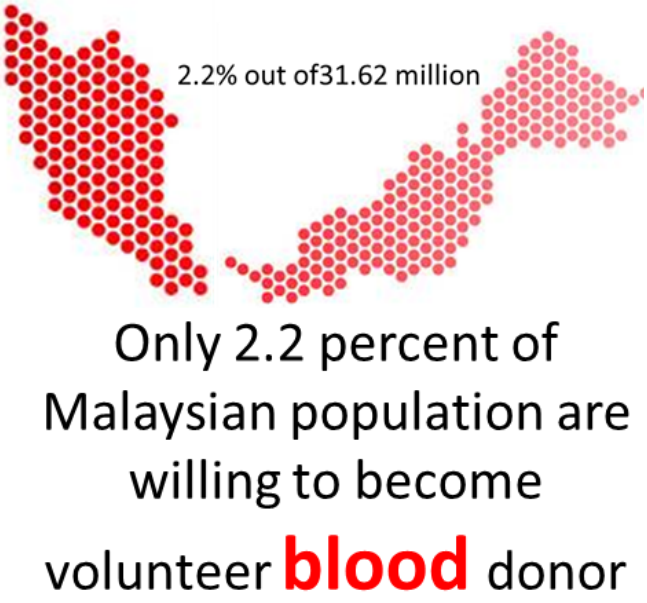
i) Lack of promotion: promotion to attract more volunteer blood donor should be augmented. The promotion can be done through conventional media or social media. For example through Facebook, Instagram or Twitter.

ii) Myth on blood donation: rumors are being spread about donating blood. For instance, weight gain or loss, easy to get an infectious disease and will cause harm to the donor's body.

iii) Limited post-donation souvenir: the government perhaps can think of something about post-donation souvenir right after the blood donors donated blood. For example, besides giving free drink and biscuits, other types of souvenir could be provided such as a t-shirt, fridge magnet or something small but memorable.

iv) Educational publicity: there is a lack of effort has been taken in introducing about blood donation among youngster. This educational publicity should be started in primary school to give more exposure to the young ones about blood donation. At the same time, it can instill the desire and awareness to donate blood when they are eligible. For example, integrate about blood donation in the primary school syllabus.

Dependency on repeated blood donor could harm the sustainability of blood reserve and supply in the country for the long run. Therefore, the government must intensify its efforts to attract more volunteer blood donors and should be carried out as soon as possible. Nevertheless, public awareness is equally important too. Without support from the public, the blood donation program would be difficult to be implemented.



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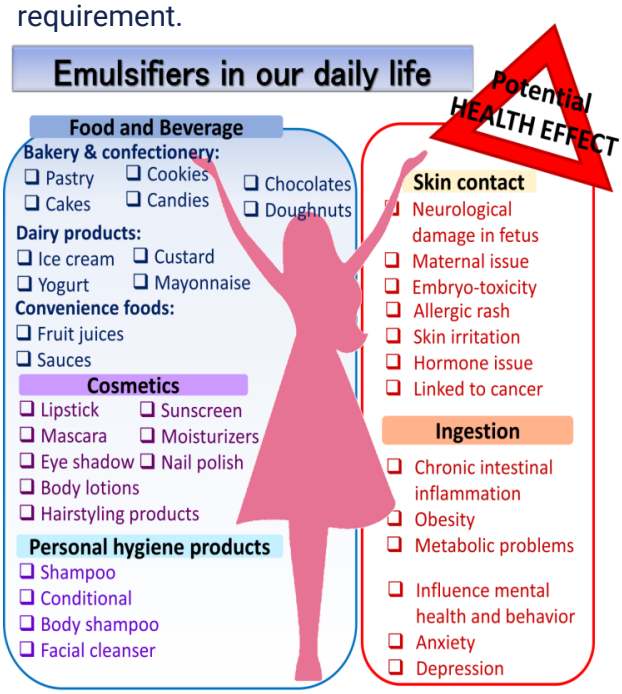
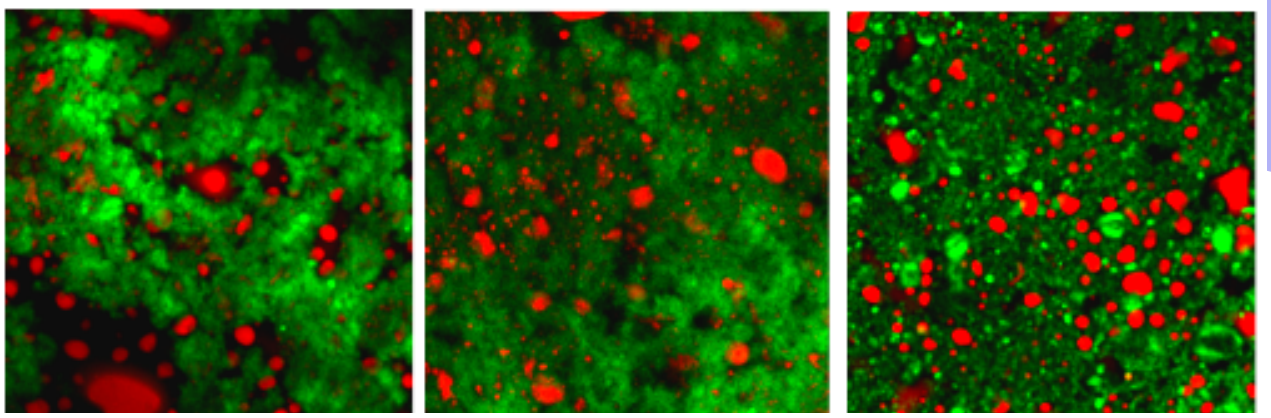
RENEWABLE BIOMASS-DERIVED CELLULOSE NANOMATERIAL: VERSATILE BIO-BASED EMULSIFIER

Emulsifier for wide range of product formulations (Source:Hygiena)

Did you know, >70% of the emulsifier usage have direct and in-direct contact with the human. The emulsifier is everywhere in our daily application, such as food & beverage, personal hygiene product, cosmetic and pharmaceutical products. The emulsifier act as a 'hand-holder' between the oil and water phases, which ensure the ingredients remain mixed and not separate at any point from start to the end process. Chemically, an emulsifier that consists of one "water-loving" end and the other "oil-loving" end, so it can link with each other to form a stable emulsion.

Although emulsifier shows good functionality in a wide range of product formulations, however, over-usage might lead to potential in consumers' health risk. As the consumer's demand on better "taste" or "feel" of the products, heavy load of different types emulsifiers are applied in one formulation that all working to create a desired texture/ mouthfeel of the product. Have you ever wondered what those emulsifier numbers in the ingredients list on your daily product packaging meant and what they were doing to your body? Some recent study suggests synthetic emulsifier have a high possibility of increasing our risk of allergies, obesity and chronic diseases, especially for ingestion and skin contact. Due to this reason, consumer concern about healthy and sustainability-focused lifestyle has led to an increase demand for a natural product with "free-from" chemical claims. This has encouraged manufacturers to use a natural emulsifier in the product formulation as clean label requirement.





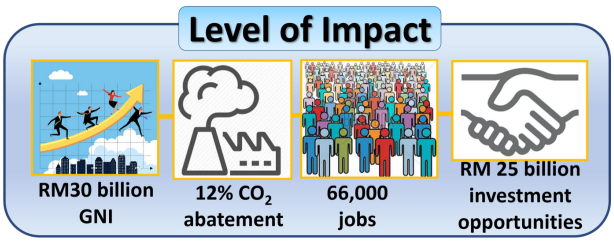
CLSM images of modified nanocellulose stabilized oil-water system

A nanomaterial engineering technology in the emulsion system has been developed to address issues related to health concerns and sustainability. A bio-based nano-emulsifier was developed from natural resources, which act as an alternative for traditional polymers and non-biological solid especially in the fields of food, comestic, and drug delivery system. Nanocellulose-derived from agriculture biomass and fruit wastes constitute the most abundant renewable polymer resource available today with low toxicity and high biocompatibility. The nanocellulose materials present in the form of rod-like nano-crystalllites shown different unique properties; where both hydrophobic and hydrophilic phases are exits. Besides, the presence of self-assembling ability at liquid-liquid interfaces, high aspect ratios with nanodimension in width or length, large surface area, lightweight, while the chemical structure is preserved during dispersion in emulsion facilitate its use as particle-stabilized Pickering systems. Furthermore, tunable functional groups of nanocellulose surface available for modification and grafting allow further control to attain supra-structures and highly hierarchical assemblies, much resembling the original, precursor cell wall of fibers. Compared to the traditional surfactant-based emulsifier, the modified nanocellulose particles capable to form ultra-stable and mono-dispersed emulsions, which offer advantages in terms of cost, purification, and production scale, without compromising biocompatibility, stabilizing capacity, and versatility. This product renders the multi-functionalities in encapsulating, stabilizing, thickening and delivering functional compounds, which leading to products which have more potential advantages than conventional emulsions. Thus, it is potential to apply as a fat replacer for low-calorie foods, encapsulation of drugs through interfacial networks for therapeutics, and high water holding capacity that favourable in cosmetics formulation.

Commercial Potential

If Malaysia cover **2%** of the total nanocellulose market (USD 65.0 million market), it will generate **1.0 million of sales** forecast for every year.

Level of Impact



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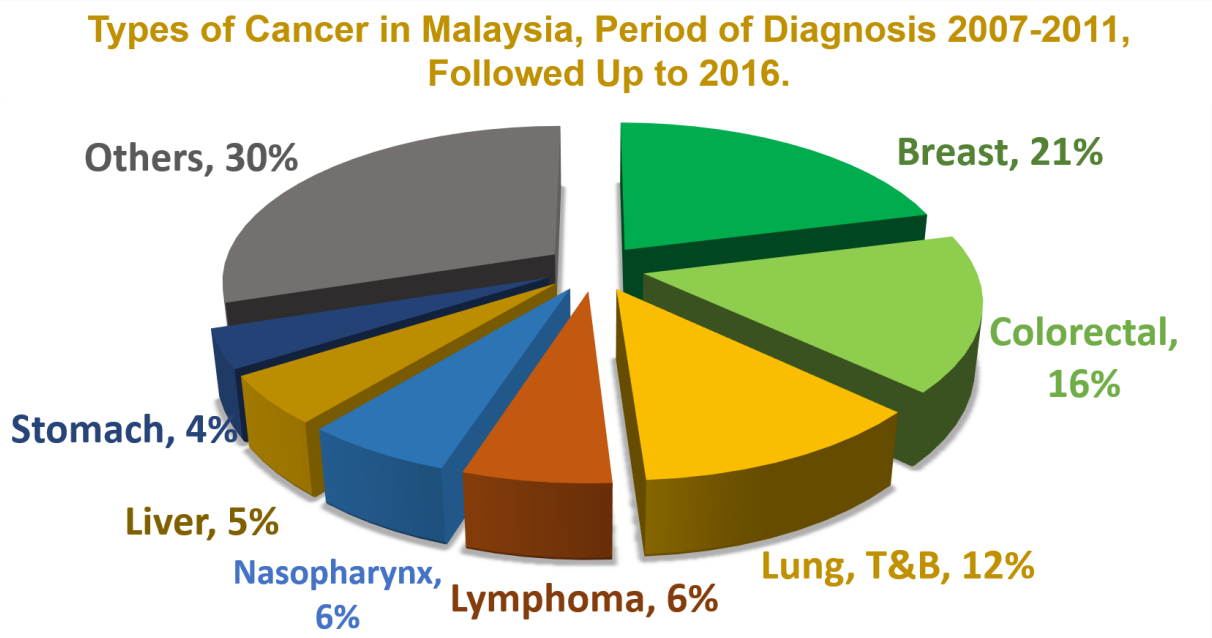
LASER-DRIVEN HOT NEEDLE FOR PERCUTANEOUS HYPERTHERMIA CANCER THERAPY



Cancer is the fourth most common cause of death in Malaysia. The National Cancer Registry of Malaysia (NCR) estimates that one out of four Malaysians (1:4) will develop cancer by the age of 75. It is approximately 37,000 newly-diagnosed cases of cancer every year, and this figure is expected to breach 66,000 by 2030. Consequently, cancer has become a major economic and societal burden in Malaysia.

There are several types of energy sources for hyperthermia treatment, such as focused ultrasound, microwave, radio-frequency, and laser have proven to be effective in cancer treatment such as in breast, lung, liver, kidney, bone, etc. Focused ultrasound and microwave have their advantageous in clinical outcomes. However, these devices suffer several complications such as produced heat zone, compactness of the needle, as well as the costs of these devices might significantly limit the accessibility of these treatments to the medium to lower-income population. Thus, Radiofrequency Ablation (RFA) is probably the most commonly used for local hyperthermia therapy. The operating principle of RFA is based on heat generation and conduction to the tissues by electric alternating current. An electrical needle/probe is inserted to the targeted tissues and a grounding pad is physically attached outside the body of the patient to form a closed electric circuit. The shape of the ablation zone relies on the heat conductivity properties of the surrounding tissue and the position of the grounding pad, this constraint restricts the performance and efficacy of RFA in cancer therapy.

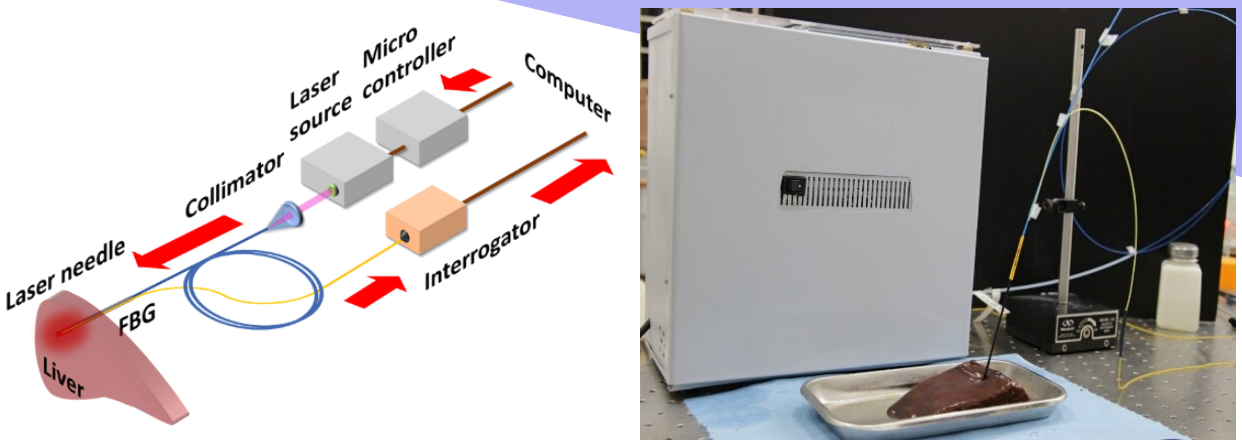
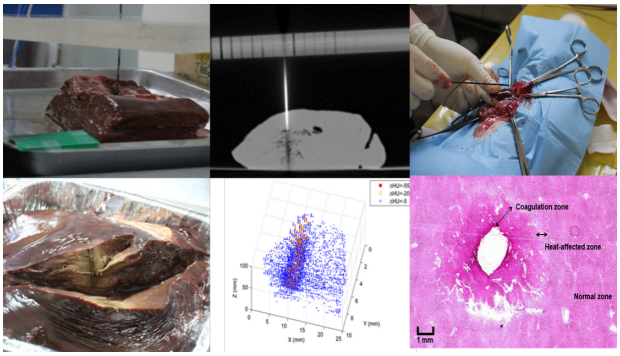
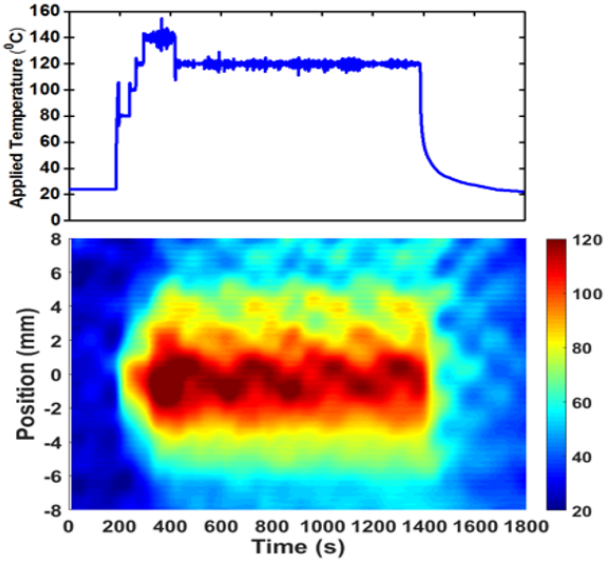


Fig. 1: (a) Schematic diagram and (b) prototype of the laser driven hot needle.

This limitation can be overcome by adopting a laser-driven hot needle in cancer therapy. A closed-loop control system which comprises of Fiber Bragg Grating (FBG) temperature sensor, a medical-grade multi-mode fiber and a micro-controller can be assembled for homogeneous tissue ablation (See Fig. 1). Based on real-time temperature input from the FBG sensor, the micro-controller can perform a dynamic PID control on laser intensity for safe hyperthermia treatment. The fiber-based hot needle is an ultra-thin device that is fabricated from a low-cost fiber optic components, which makes this disposable device at an affordable price and safe for the patients. A dynamic temperature control system with embedded fiber based temperature sensor inside a compact hot needle enables real-time needle temperature monitoring to enhance the effectiveness of the treatment. In addition, the use of FBG temperature sensor to replace the conventional temperature sensor can miniaturize the hot needle that is more likely to cause less collateral damage to the tissues during the percutaneous procedure.

In overall, the laser-driven hot needle is designed not only to solve the technical challenges in the current local hyperthermia therapy but also in consideration of the social and economic factors to make cancer treatment more accessible and affordable.





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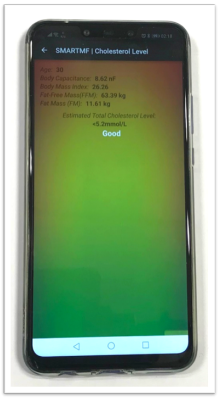
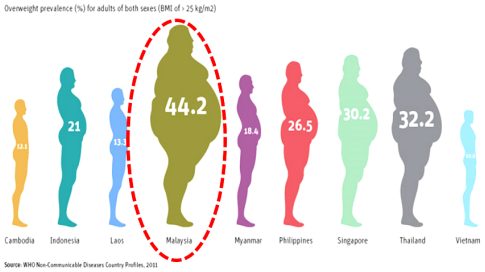
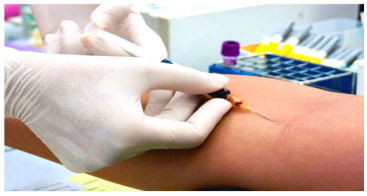
NON-INVASIVE SMARTMF CHOLESTEROL MONITORING SYSTEM





Cholesterol Home Test

Cholesterol Lab Test

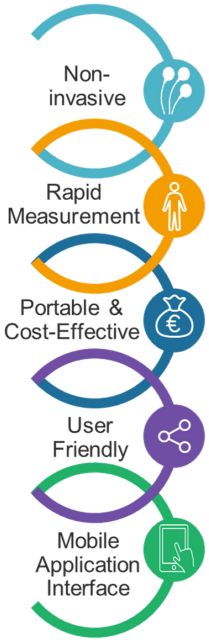


SMARTMF is a smart portable multi-frequency bioimpedance analyser (BIA) for cholesterol monitoring system developed by the Centre for Innovations in Medical Engineering (CIME), University of Malaya. Called SmartMF, the device measures changes in tiny electric pulses to track total cholesterol level.

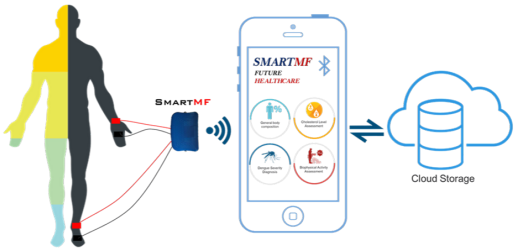
Over the past 15 years, Prof. Ir. Dr. Fatimah Ibrahim and colleagues at the University of Malaya have been studying the relationship between water and fat percentages in the body and various health conditions. The team compared bio-impedance analyser measurements to conventional blood tests for 825 people and found statistically significant correlations. They used this information to develop equations that predict conditions with high levels of accuracy.

260 healthy volunteers were also recruited to provide blood samples and BIA measurements to investigate the relationship between body composition and total cholesterol. The study found that SmartMF can predict if total cholesterol levels in the blood are within a normal range or high with more than 80% accuracy using an artificial neural network, as reported in the journal Biomedical Engineering: Applications, Basis and Communications.

Similarly, blood samples were collected from 205 patients with dengue to measure haemoglobin and platelet levels. The haemoglobin and platelet count are significant indicators if a patient with dengue is showing signs of recovery or of progressing to the more severe stages of the disease. BIA measurements of these same patients were collected also to develop and improve the algorithm. The SmartMF system can predict severe dengue risk with more than 95% accuracy compared to regular lab tests, the researchers report in the journal Medical & Biological Engineering & Computing. Based on those findings, the team combined their software with a small sensor that measures fat mass and water in the body, and the results are relayed to a smartphone.



Home-based device
Continuous monitoring
4 hours fasting



HEALTH MANAGEMENT AND CHOLESTEROL MODULE

- ✓ Body composition
- ✓ Total Cholesterol (TC)
- ✓ High Density Lipoprotein (HDL)
- ✓ Low Density Lipoprotein (LDL)
- ✓ Triglycerides (TG)

The SmartMF system uses a commonly used technique, called bioimpedance analysis (BIA), to measure body composition. Four electrodes are attached to the skin — two on the right foot and ankle and two on the right hand and wrist—which are connected by wires to a small electrical device (8 x 4.5 x 2 cm). The device sends a minute electric signal to two of the electrodes. These electric current passes quickly through the body's water content but finds resistance in fat cells, and the diminished signal is detected by the other two electrodes. The change in voltage of the electric signal indicates the levels of water and fat in the body.

Fatimah and her colleagues have been able to show how a relatively simple measurement like BIA can correlate to specific health conditions.

SMARTMF can address the drawbacks of conventional blood testing i.e. painful blood drawing procedure, time-consuming analysis, and requiring professional healthcare assistance. Besides, SMARTMF will able to provide a database on the blood lipid profile risk level and assist the user in monitoring their cholesterol level periodically.

By avoiding the need for collecting blood samples and expensive lab tests, the non-invasive sensor can help reduce healthcare costs while making it easier to closely monitor health changes.

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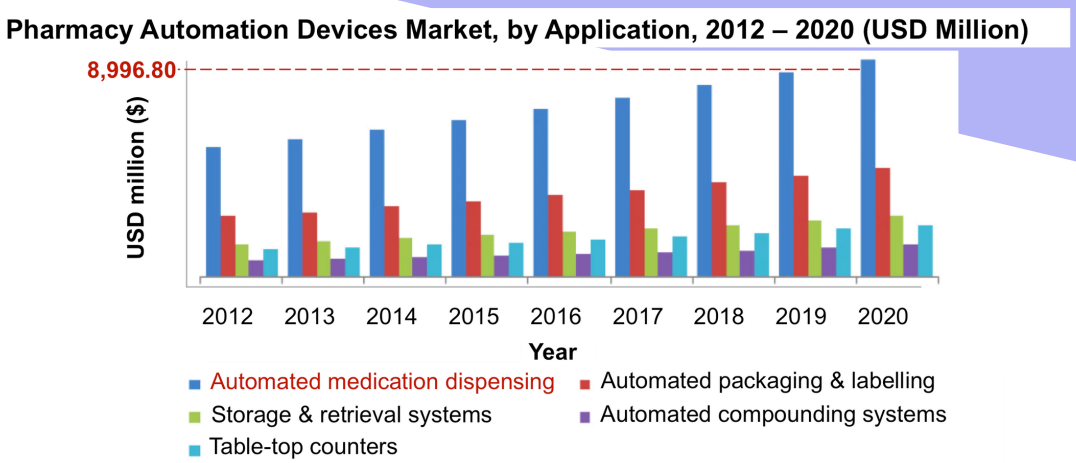
AUTOMATED METHADONE MACHINE DISPENSER FOR METHADONE MAINTENANCE TREATMENT PROGRAM

In Malaysia, drug addiction problem is regarded as a nation chronic disease that still entails long term treatment and support even though the government has spent over a million ringgit to overcome it. In 2005, Malaysia has started in a government facility to provide methadone maintenance treatment (MMT) program, a psychotropic medication method to opioid dependence patients. This program is initiated to effectively overcome the addiction problem by using methadone syrup, a controlled medicine that can only be dispensed by authorized health practitioners or pharmacists to avoid any misconducting while doing the treatment process. Currently, the program has involved a few agencies such as prisons and the National Anti-Drug Agency (NADA) premises. In NADA, the program was implemented in Cure & Care (C&C), Cure & Care Service Centres (CCSC), drug rehabilitation center and possibly to be extended to reach more drug addicts.

It is no doubt that MMT program has reported success in reducing drug retention rate of opioid dependence patients. It was reported that patients on methadone treatment showed improvement in the quality of life which demonstrated by reducing heroin use, HIV risk behavior and criminal activity. However, a part of the program itself has far encountered many challenges during its implementation. There were complains from the health practitioners or pharmacists on the dispensing process due to the usage of the syringe during manual dispensing had caused severely exhausted hands and prone to human error. This conventional manual methadone dispensed by syringe if prolonged will lead to carpal tunnel syndrome caused by compression of the median nerve at the wrist whereby if severe will result in hand weakness. The patients registered under this program are likely allowed for a maximum of seven bottles of take-home methadone dose which needed



The growth of automated medication dispensing grows at an estimated CAGR of 7.3% from 2012 to 2020 in the market and is expected to reach USD 8,996.80 million by 2020. (Source: Prior art search report for University of Malaya by PlaTCOM Ventures Sdn. Bhd.)

Tangible Cost				
Year	**Addiction Treatment**	**Patients**	**Cost (RM)**	**Relapse Rate**
Up until late 1990s	Rehabilitation centres (*pusat serenti*)	100,000	Annually = 300 million Monthly = 3,000/patient	**90 %**
2002 - 2022	Methadone Maintenance Treatment (MMT) program	318,408	Annually = 127 million Monthly = 400/patient	**10 %**

them to drink up to seven days of each bottle. Since the methadone syrup is highly concentrated with thick solution, thus the full force of energy is required during dispensing. Besides, each patient coming for the treatment has required to different intake of methadone doses depending on each patients' history of the drug intake. Consequently, this has resulted in a high percentage of error such as non-accuracy dispensing and inefficient dispensing flow due to human error. The number of patients treated by the pharmacists per day is also low due to the management and time taken during methadone treatment therapy are inefficient.

Automated methadone dispensing machine is locally designed and fabricated for MMT program mainly to maximize pharmacist workflow productivity, reduce the occupational hazard of carpal tunnel syndrome and improve the performance procedure of methadone treatment therapy. To ensure the feasibility of the machine, the machine performance was evaluated through efficiency and accuracy tests that are thoroughly investigated to solve existing problems with the manual dispensing process.

The developed prototype machine has used the concept of portability for easy to be carryied anywhere. A simple wire connection between the machine and laptop give direct end-user interactions for machine operation by simply clicking the button to dispense, withdraw and flush through the command window. Besides, the machine is proven to be highly efficient and accurate in conducting the methadone dispensing process, provided excellent stability of the mechanical parts. It is hoped that the automated methadone machine dispenser will further reduce the alarming high relapse rate of drug-addicted patient and at the same time significantly improve their quality of life under current treatment program.

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ERASMUS+ CAPACITY BUILDING IN HIGHER EDUCATION

'BUILDING SOCIAL RESEARCH CAPACITIES IN HIGHER EDUCATION INSTITUTIONS IN LAO PDR AND MALAYSIA (BRECIL)'

brecil Erasmus+ KA2 CBHE

Co-funded by the Erasmus+ Programme of the European Union

BRECIL is a project acronym for 'Building Social Research Capacities in Higher Education Institutions in Lao PDR and Malaysia'. It is a multi-partner project led by University of Malaya (UM) (Prof. Dr. Azirah Hashim, Prof. Dr. Low Wah Yun and Prof. Dr. Noor Hayaty Abu Kasim) with universities in ASEAN (Universiti Utara Malaysia, National University of Laos and Souphanouvong University, Laos) and three universities in Europe (University of Gothenburg, Sweden; University of Groningen, the Netherlands and University of Applied Languages (UAL/SDI), Munich, Germany.

The project builds on previous capacity building experiences of UM carried out under the Ministry of Higher Education's CLMV (Cambodia, Laos, Mynamar, Vietnam) programme as well as the interdisciplinary ASEAN research programme at the Centre for ASEAN Regionalism UM (CARUM), and existing cooperation and relationships established between the Asia-Europe Institute and Lao Higher Education Institutions and European universities.

BRECIL has the wider objective of developing human capital and facilitating individual learning and institutional mechanisms in Social Science research in higher education institutions (HEIs) in Lao PDR and Malaysia. In order to fulfill the general objective, the project has specific objectives with the first aiming at developing and empowering researchers in the Social Sciences via training and peer

learning to design, prioritize and undertake research, write up and publish research findings and inform policy. The second objective is to develop good governance of research by enhancing the capacity of research departments and teams in universities, to fund, manage and sustain themselves. The final objective is to create a sustainable research capacity building programme in the Social Sciences including the utilization of ICT technologies. Dissemination to society at large by the partners and associated partners is actively carried out. The project aims to raise the competence of academics in Laos and Malaysia. It also intends to expand the knowledge economy agenda and build a higher education area linking Asia and Europe by supporting the assimilation of knowledge between the EU and ASEAN.

Research training sessions (via Training of Trainers)have been conducted extensively at two Lao partner HEIs to ensure greater outreach and access. Although the main audience consists of selected Master Trainers from the Lao partner institutions, training sessions will also be open for participation to

Coordinator: University of Malaya, Asia-Europe Institute

Partners: UUM, University of Gothenburg, university of groningen, SDIMUC

Associated Partners: immi, EU-Malaysia Chamber of Commerce and Industry

academics in other institutions in Laos when cross-training is conducted in associated partner universities, namely, Savanakkhet University and Champassack University. Master trainers will have an excellent avenue and practical opportunity to reach out and to train academics who have little access to research education opportunities.

The project started with the preparatory phase that established the foundation to support and facilitate subsequent development work packages' planning, implementation and production of deliverables and outputs. This included stock taking to assess existing situations and circumstances, reports such as Institutional Reports and Country Reports,preliminary risk assessment, needs analysis, and action plans for all project work packages. The kick-off meeting was organized at the National University of Laos in Vientiane in early 2018, where all partners from different universities gathered to discuss the project planning and implementation. Workshops and seminars were held at University of Malaya, Universiti Utara Malaysia, National University of Laos and Souphanouvong University on Quality Assurance, Training of Trainers and a Study Tour on Research Governance was conducted at University of Groningen in 2018 and 2019. Cross Training and other seminars will also takeplace in Laos in 2020.

The project offers higher education institutions in ASEAN an opportunity for regional cooperation, not only within ASEAN, but also,with EU institutions. Innovative elements include assimilation of good practices from two different regions, engagement with a wide group of stakeholders to ensure relevance and reflect societal needs, use of ICT in research development, integration of practices of good research governance and research training, a manual on research methodology with a local and regional focus, and a comprehensive dissemination strategy to share the learning from the project with the higher education community and other stakeholders.

The direct or indirect beneficiaries of this project are:

i) Institutions - mobilizing personnel and upgrading infrastructure and mechanisms of research offices in Lao universities; research governance in Malaysian higher education benefits from exchanges with EU universities.

ii) Academics in Lao universities - change in attitude and mindset about doing research. The Training of Trainers programme enhances teaching through knowledge transfer from both ASEAN and EU research experts.

iii) Students - exposure to new methods in research and different ways of learning and necessary skills and knowledge that will enable them to carry out research.

iv) Policy makers - expected impact at the policy level in both Lao PDR and Malaysia due to the commitment of the Ministry of Education and Sports, Lao PDR and the Ministry of Education Malaysia. Through these collaborative efforts, results of the project will be disseminated through suitable channels and reach target groups.

v) External partners - collaborations with the Asia-Europe Education Secretariat (ASEM), the EU-Malaysia Chamber of Commerce and Industry (EUMCCI) as well as industry partners affiliated to partner universities will ensure the relevance of the project to industry needs.

#The project website can be accessed via http://brecil.my

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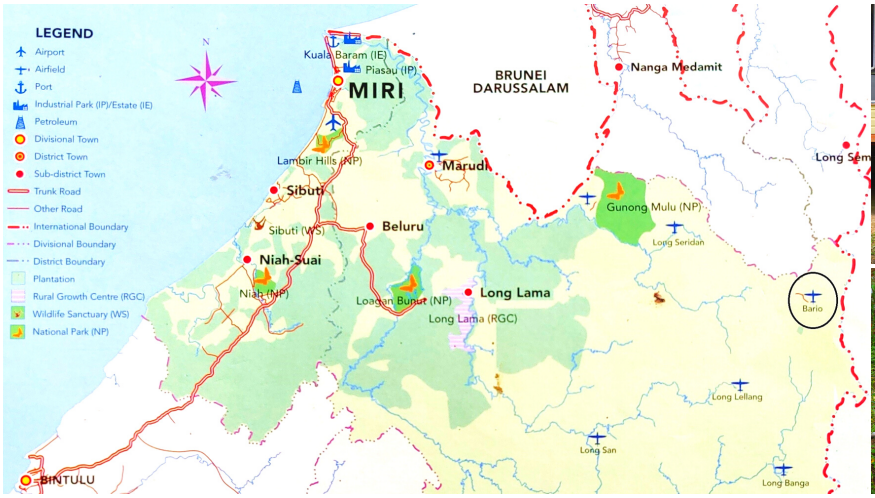
RURAL REALITY: WASTEWATER MANAGEMENT IN BARIO, SARAWAK



Bario is a remote area of Sarawak located on the Kelabit Highlands, at an altitude of 3500 feet above sea level, covering an area of 3,850 km^2. It is located in the middle of thick forest, close to Sarawak-Kalimantan border, with the only access is either by 55-minutes flight with 16-seater twin otter plane or 14-hour drive with four-wheel drive (4WD) using logging trail. Bario community consists of 6,000 people of 13 to 16 villages with a small number of roads linking between them. Bario is drained by four small streams, Remapoh, Arur Laab, Arur Dalan and Merarui rivers, averaging in one to four metres in width, which converge into Dapor river.

Due to its remoteness, the limited infrastructure facilities that are provided are often inadequate, hence resulting in a poor and often deteriorating environment. Electricity generated through solar panels was just implemented in less than five years while drinking water treatment facilities are still under construction, expected to be in operation in 2020. As for the sanitation system, no plan seems to be in place as it is now. Currently, the sewage is discharged into the steel drum barrel with 200 L capacity that after years of usage, become corroded, and leak out into the ditch. While the sullage is directly discharged into the ditch, making the ditch functioning as an open sewer system, before being released untreated into Merarui river.

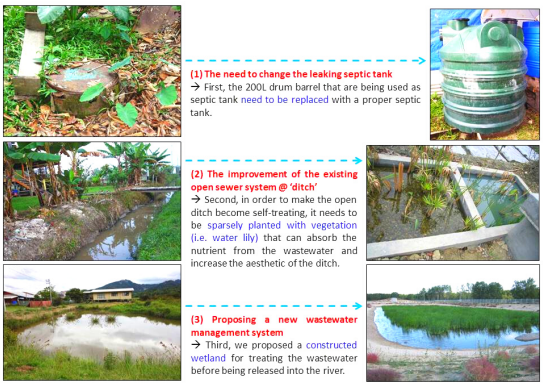
In Bario, they are two main indigenous tribes inhabited the area. The main tribe Kelabit inhabit the town and small villages scattered around the town. While the Penan tribe inhabit the jungle at the perimeter nomadic indigenous people that tend to build their settlement deep in the jungle. But now, as they have been exposed to the outside world, they tend to build their houses, together with outhouse toilets, at the edge of the jungle, hence, contaminating the river with human excretion. Therefore, it becomes imperative to investigate the quality of the surface water used as a main source of the water supply for Bario.

Surface water samples are collected at 8 sampling sites in Bario and analyzed for pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Ammonia (NH_3-N) and E.Coli. In accordance to DOE WQI, all sampling sites exhibit water

quality within class III (moderate), with the following order in term of its quality from best to worse, Arur Dalan river > Merarui river > Dapor river > ditch. Arur Dalan River flows mostly through the jungle and only small stretch flow through the town of Bario, hence, explaining its better quality. In general, the water may still be used for water supply but extensive treatment is crucially required. Additionally, the analysis has highlighted a crucial issue, that is, ditch and rivers posed high organic content (i.e. COD, BOD) and highly contaminated with ammonia (i.e. NH_3-N) and pathogen (i.e *E.Coli*). The primary source of these contaminants is believed to be originating from human excretion from the leaking septic tanks and outhouse toilets. High ammonia, other than causing eutrophication, will pose huge technical implications to the water treatment plant operation. High ammonia content will cause the chlorine disinfection to becomes ineffective. The disinfection system will need more chlorine as the chlorine will first need to react with all the available ammonia before it starts disinfecting the pathogen. Moreover, the reaction of ammonia and chlorine will form disinfectant by-products that are more dangerous than the original form of ammonia and chlorine.

Concerning that, solutions that target all three levels of wastewater management system of Bario are proposed: i) To replace the 200 L drum barrel that is being used as septic tank with a proper septic tank; ii) To make the ditch becoming self-treating, vegetation (i.e. water lily) needs to be sparsely planted to absorb nutrient from the wastewater as well to increase the aesthetic of the ditch; iii) To build a constructed wetland as a treatment for the wastewater before being released into the river. Ecological engineering solutions like vegetated ditch and wetland are the most suitable treatment system for rural areas due to: firstly, these two engineering solutions are excellent in removing nutrients especially ammonia, as the vegetation will absorb the nutrient from the wastewater. They are also good in removing pathogen like *E.Coli* as the vegetation root system will serve as a filter and harbor for the pathogen to attach themselves to. Secondly, the solutions require low and easy maintenance routine. Once the vegetation has grown, the only maintenance needed is to prune the vegetation every couple of months. It is very critical not to allow the vegetation decay in the ditch and wetland as the decaying vegetation will release the nutrients from the plant back into the water. Other than that, the solutions have a very high aesthetic value and will enrich the biodiversity of the surrounding area. Thirdly, residents of Bario are all paddy planters and experts in planting paddy, managing an irrigated paddy field and handling piping and channelling. Hence, they have all the skills needed to help in maintaining the wetland. Fourthly, the solutions are also perfect example of a self-reliance solution for wastewater management in rural areas like Bario. Apparently, for any technical systems to work successfully in rural areas, it has to be self-reliance.

In conclusion, as the sewage will be treated in septic tanks, and the sullage and surface water in the ditch will be treated using vegetated ditch and wetland, Bario has huge potential to facilitate more sustainable, economical and effective wastewater management system.



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FIRST GEOPOLYMER CONCRETE HOUSE (CEMENT-FREE SUPERSTRUCTURE) IN UM

The overuse of conventional building materials such as cement, sand and coarse aggregates negated the ecological balance; this has resulted in a shortage of building materials and serious environmental catastrophe including flooding in many countries. As the demand for ordinary Portland cement (OPC) continues to rise, finding alternative binders has become more crucial. It has been stated by the U.S. Geological Survey that China used more cement between 2011 and 2013 than the U.S. in the entire 20th century. The manufacture of each ton of cement produces about an equal amount of carbon-di-oxide (CO_2). The CO_2 emission during cement production has been a major concern and motivated researchers to explore alternative binders. Thus, as the research outcome, alternatives to OPC have been proposed to reduce greenhouse gas emissions.

During the last 2 decades, the Centre for Innovative Construction Technology (CICT), Department of Civil Engineering, Faculty of Engineering, UM initiated a series of research works on the utilization of industrial by-products and wastes as building materials to replace the conventional materials wholly including cement. In any research output, the collaboration between industry and researchers is crucial in exploring such new materials and technology. Thus, in 2016, CICT and Vinci Construction Grands Projets Sdn Bhd (VINCI) signed a memorandum of understanding (MoU) and subsequent Memorandum of Agreement (MoA) on the funding for construction of a cement-free superstructure also known as Geopolymer Concrete House (GPCH) within UM campus. The project was led by the Director of CICT, Assoc. Prof. Dr. U. Johnson Alengaram. He and his research team which consisted of Research Assistants had Prof. Ir. Dr. Mohd Zamin Jumaat, as their advisor. GPCH was planned and constructed such a way that the five rooms in the building are to be shared between CICT for research purpose and bus drivers as their office and resting rooms.

Locally available industrial by-products such as fly ash (FA), ground granulated blast furnace slag (GGBS) and palm oil industrial waste-palm oil fuel ash (POFA) were used to

develop geopolymer concrete (GPC). Depending on the product criteria and necessity for precast completion within the stipulated time, oven dry and ambient curing was used. The development of building product and mix design for the GPCH was based on geopolymer technology that used activation of industrial pozzolans as a precursor.

The whole cement replacement materials used in this research project are FA, GGBS, and POFA as precursors. FA is an industrial by-product from thermal power plants and is available in abundance in Malaysia. Further, GGBS, a by-product of iron and steel-making industry is available in Malaysia; POFA was processed in UM laboratory and used as a precursor. As these binders have calcium-alumina-silicate characteristics, geo-polymerization of these precursors by activating through alkaline activators enables stable products. FA, GGBS and POFA were activated using alkaline activators.

Quarry industrial by-product, namely Manufactured sand (M-sand) was used as whole fine aggregates replacement for conventional mining/river sand. As the whole replacement for conventional crushed granite, palm oil clinker (POC) aggregates-another waste material from the palm oil industry were used as a raw material in the development of cement-free building products. Thus, the whole superstructure was made of green and sustainable materials.

The construction of GPCH consisted of foundation (piling and raft-using OPC concrete of grade 30), cement-free grade 30 GPC precast interlocking exterior wall panels, and two types of cement-free GPC blocks for internal walls. Owing to weak soil condition at the site, piles and raft footing were used. Columns, tie beams and main beams were constructed using cast-in-situ GPC which didn't require any heat curing. Further, no heat curing was required for exterior interlocking wall panels. To provide rigidity to the interlocking panels, tie beams made of GPC of grade 30 were provided with both at the bottom and top of windows. Further, to ensure an appropriate connection between the column sand beams with the wall panels, suitable inter-connectivity was done. The in-situ concrete for the tie beams, main beams and columns were prepared at the site and the concrete was allowed to cure under ambient temperature.

Another salient point is the use of plastic aggregates in the GPC for the pavement. The density of GPC was found in the range of 1900 kg/m^3 and thus, it makes the concrete as lightweight; besides, due to its flexibility and sustainability aspect, this kind of pavements can be vital to reducing plastic wastes that contaminate the landfill.

The geopolymer concrete house comprises of about 710 sqft of built-up area was officially opened on 21st October 2019 by the honorable Deputy Vice Chancellor (Development), Prof. Ir. Dr. Abdul Aziz Abdul Raman and attended by Mr. Gilbert Ferry from VINCI Construction Grands Projets Sdn Bhd, Prof. Dr. Shaliza Ibrahim, Associate Vice-Chancellor (Research), Prof. Dr. Saad Mekhilef, Dean of Faculty of Engineering and other dignitaries also joined and commended the project. The event was well attended by company representatives from many industries and researchers.

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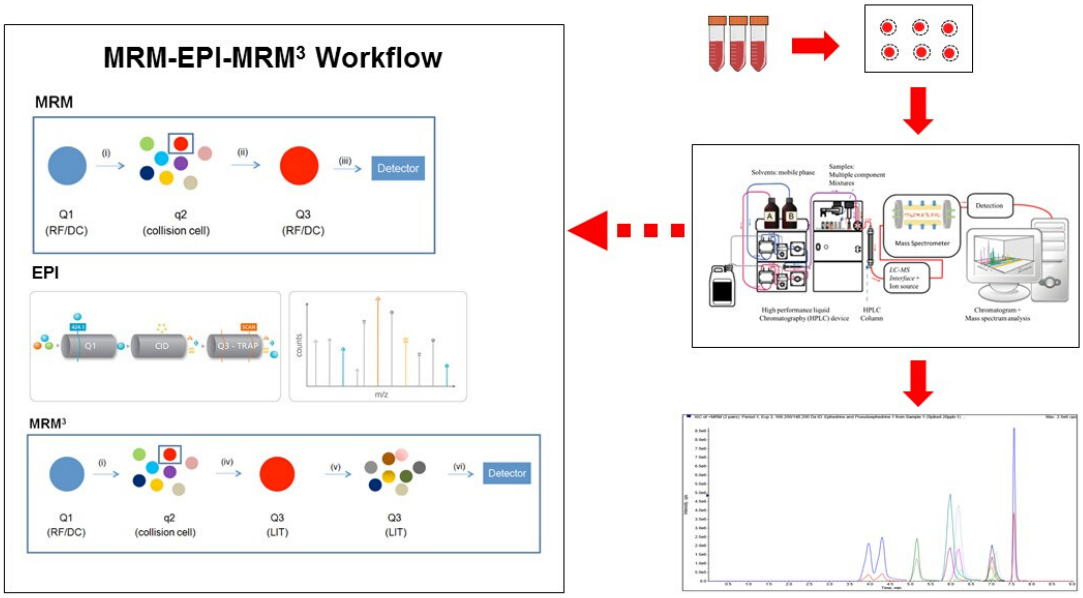
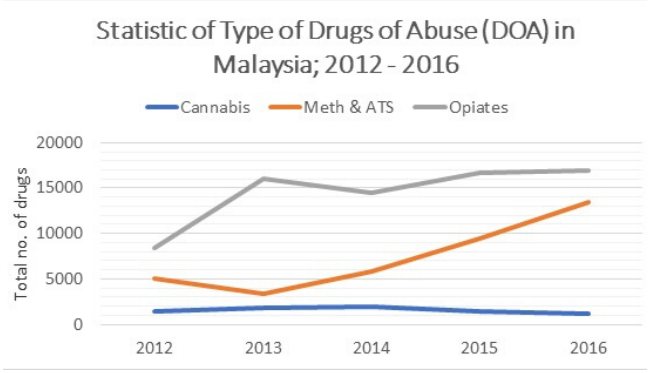
DETERMINATION OF AMPHETAMINE-TYPE STIMULANTS (ATS) IN FORENSIC TOXICOLOGY



The amphetamines and related drugs are agents which can stimulate the central nervous system (CNS) producing undesired mental function and behaviours, and are classified as a drug of abuse (DOA) in Malaysia. The two major regulations governing DOA in Malaysia include the Dangerous Drugs Act (DDA 1952) and Poisons Act (PA 1952), which fall under the Criminal Procedure Code (CPC) and carries heavy punishment. However, the Armed Forces Act 1972 applicable to the Royal Malaysia Armed Forces, only imposes mandatorily charges for the armed personnel caught with DOA. The Amphetamine-type stimulants (ATS) comprise a wide range of illicit street drugs such as amphetamine, methamphetamine, methcathinone, the ecstasy-group substances (3,4-methylene-dioxy-N-methylamphetamine (MDMA) and its analogues), and also those usually employed in therapeutic approaches, such as methylphenidate (MPH), amphepramone or diethylpropione (DIE), mazindol, and fenproporex (PPP).

The occurrence of isomeric ATS (e.g. pseudoephedrine-ephedrine and phentermine-methamphetamine) presented a major challenge in the identification and determination analysis. It is important to accurately differentiate the isomeric ATS as the punishment is different for the usage of these ATS. For example, consuming phentermine to maintain body mass index (BMI) in the Malaysia Royal Armed Forces is permitted under prescription by a physician, but having methamphetamine is prohibited under the Armed Forces Acts 1972.

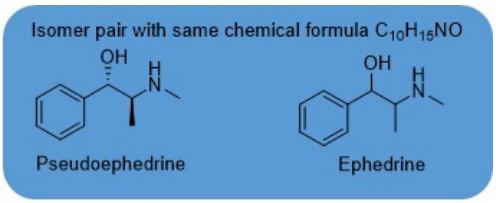
The high prevalence of ATS drugs abuse together with the complicated background of toxicology cases has urged for a rapid and simple confirmatory approach. A fast, robust, and efficient LC-MS/MS technique using MRM-EPI-MRM3 for simultaneous determination of ATS in dried blood stain (DBS) was developed. The application of DBS matrix presented an inexpensive, innovative, simple, and efficient technique for drugs detection. A multi-period and multi-experiment workflow strategy are adopted in the LCMS system to resolve the isomeric ATS. While the multiple reaction monitoring (MRM) and MRM3 multistage fragmentation experiments were imbedded under a multi-period experiments workflow utilizing enhanced product ion scan (EPI) experiment protocol for identification and confirmation. The first LCMS transition (MRM) corresponds to the most abundant product ion was used for identification and quantification, while the second transition (MRM3) was used for confirmation purpose The ATS-related drugs analysed in this study include, ephedrine, pseudoephedrine, amphetamine, methamphetamine, MDMA, MDA (3,4-Methylenedioxyamphetamine), MDEA (3,4-Methylenedioxy-N-ethyl-amphetamine), and phentermine. The method validation was performed according to the Scientific Working Group for Forensic Toxicology Standard Practices for Method Validation in Forensic Toxicology and the United Nations Office on Drugs and Crime Guidance. The new method was applied to the whole blood sample (WBS), DBS, urine, and the proficiency testing samples.

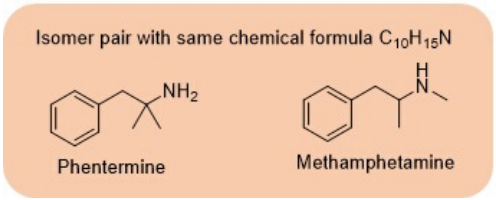


The accuracy calculated from measured and intended responses (determined previously from real forensic toxicology cases in Malaysia) ranges from 83.3-106.7% for the entire tested analytes, and successfully applied to several real forensic cases in Malaysia.

In summary, a novel mass spectrometry detection technique based on a multi-period and multi- experiment (MRM-EPI-MRM3) with library matching in a single run for fast and rapid screening and identification of ATS related drugs in WBS, urine and DBS was developed and validated. The relative standard deviation for inter and intraday was less than 15% while recoveries ranged from 80-120% for all three matrices, i.e. whole blood, urine and dried bloodstain. All compounds gave library matching percentage of more than 85% based on purity. This method was proven to be simple and robust, and provide high confident results complemented with library matching confirmation.

This research work was carried out by Mdm Fathiah Binti Ahmad Zubaidi for *Jabatan Kimia Malaysia* as part of her PhD dissertation.





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LIGNIN EXTRACTION FROM COCONUT SHELL USING APROTIC IONIC LIQUIDS

Photo by Jonas Dücker on Unsplash

Malaysia is fortunate to be blessed with an abundance of natural resources such as coconut, palm oil, rubber tree and paddy. Which also means, Malaysia generates a large amount of agricultural waste or also known as lignocellulosic biomass. The common practice sees these agriculture waste discarded or burnt. Recently however these practices have evolved to incorporate sustainable environment growth.

Biomass is no longer merely a waste, it is a treasure trove of outstanding potentials. These biomass resources have shown great potential as a sustainable alternative to petrochemicals. We believe it does not just end there, so we have decided to explore further and for that, we have chosen a coconut shell. In our daily life in Malaysia, it is quite impossible not to come across coconut milk in at least one dish. Our neighbourhood shop itself generates loads of waste in the form of a coconut shell, which is just chartered away bio-waste most of the time.

Coconut shell is made of lignocellulosic biomass, which is mostly composed of three chemical fractions or precursors, cellulose (a glucose polymer), hemicellulose (a sugar polymer predominantly containing pentoses) and lignin (a polymer of phenols). Lignin is an aromatic renewable resource and the second-largest component of biopolymers. It has the potential to be converted into desirable high-value phenolic products that can replace products derived from petroleum and fossil fuels. Lignin is difficult to dissolve or extract because of the strong lignocellulosic structure. Thus, there is a need to find alternative solvents that efficiently dissolve lignocellulosic biomass and subsequently, convert it into high-value products.

Ionic liquids are generally defined as salts with a melting point below 100 ^{0}C, and it contain

organic cations and organic/inorganic anions. Ionic liquids are considered as 'green solvent' which offer huge potential, especially in scientific research due to its enhanced structures, properties and behaviours. Some distinctive features include negligible vapour pressure, non-flammability, a low melting point, and they are found in liquid form at ambient atmosphere. With the unique properties, ionic liquids have been used in diverse ranges of technologies and applications, such as biomass pre-treatment. Ionic liquids have been reported to possess an excellent capacity to dissolve organic biomass such as bamboo and macadamia nutshell. In general, ionic liquids can be divided into two groups, aprotic and protic ionic liquids. Aprotic ionic liquids consist of non-protonated cations and are prepared by the combination of alkylated organic cations with various types of anions. Recent work has reported the use of imidazolium-based Ionic liquids for the dissolution and delignification of biomass.

In our study, we introduce a greener lignin extraction process from coconut shell through the usage of aprotic ionic liquids. The unique ability of the solvent to be recycled up to four times and to enhance the biomass pre-treatment processes serve as a game-changer in the biowaste management system. Existing lignin extraction processes are known to use harsh solvents and harsh conditions, leading to low-value product conversion and worse still, environmental pollution. The tuneable nature of ionic liquids and known capacity in dissolving organic biomass makes it a desirable solvent media in bio-transformations. The work of extracting lignin from biomass using aprotic ionic liquids proves to be inexpensive, greener and cleaner with no toxic or odorous gases emission as a byproduct of the process. Lignin appears to be a potential valuable renewable aromatic compound, thus improving the sustainability and economic feasibility of the biorefinery industry, such as biodispersants, in wood panel products, as emulsifiers, in carbon fibers, polyurethane foams, automotive brakes, polymer modifiers, adhesives, binders, and epoxy resins for printed circuit boards. They can also be utilized in the industry as the principal component of thermoplastic materials.

Photo by Diomari Madulara on Unsplash

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DIGITAL HERITAGE AS A RHETORICAL TOOL FOR CULTURAL PRESERVATION

In the Mask Room, visitors pan over 24 different masks with an iPad Augmented Reality application to reveal the stories behind each artifact. (Photo Credit: Prof. Harold Thwaites)

In the 1980s, a science-fiction comedy film entitled, *Back to the Future*, starring Michael J. Fox won multiple awards, not simply for its narrative, but also its technical execution. In the film, Fox played a teenager named Marty McFly who was sent back in time and encountered all sorts of drama and emotions, which he then had to mend to ensure his future parents and family life did not turn out a disaster. Today, time travel and the idea to bring something from the past to our current state of living has always been a source of inspiration for humans. *Cultural heritage* is one method or 'package' in which the past is brought to the future, not just in museums, but also in folk songs, folk tales, traditional dress, history books, and other places.

The research explores digital/cultural heritage as a rhetorical tool for cultural preservation. The *Mah Meri Unmasked* project at UM, Kenneth Burke's theory of *identification* and other rhetorical ideas were used to discuss the ways in which digital/cultural heritage can serve as a "rhetorical tool" in community-university engagement. Besides providing an overview of important concepts and definitions, the research also focuses on applying a rhetorical lens to understand digital/cultural heritage.

Research on community engagement in the context of cultural heritage is not new. However, the studies generally take a social scientific or technical approach (e.g. 3D imaging). This study explores the topic further by looking into community-university engagement and digital/cultural heritage from a rhetorical perspective.

Dimensions of Identification/Rhetoric in Mah Meri Unmasked

The discipline of digital humanities or digital heritage is intriguing because it does not privilege one field over another. Scholars from the sciences and arts or humanities are able

Tree to Mask Process section features the process of wood sourcing to mask carving. (Photo Credit: Prof. Harold Thwaites)

to and even encouraged, to collaborate towards a common goal. This writing's mission was to further the conversation on digital humanities, heritage, and community-university engagement using a rhetorical lens. The study of rhetoric is vast. For pragmatic reasons and to stay relevant to the topic of this book, only a few rhetorical concepts were incorporated, namely Burke's *identification*, and the idea of *audience*, *contingency* and *strategy*.

Mah Meri Unmasked was made possible when researchers from the Centre for Creative Content and Digital Innovation (3CDI), and the Faculty of Languages and Linguistics, UM collaborated to collect data from the Mah Meri people, and later translated their findings into an exhibition for the public, and archived the information in the Cloud for future generations to access.

This praiseworthy effort clearly illustrated the dimensions of *identification*, which sought to create common ground between the university-faculties, and the university-community. This effort is particularly impactful for the Mah Meri and the university because it offered a venue for dialogues, keeping an open space for discourse about cultural heritage while helping to create/maintain positive emotions with regard to one's place in a community. This sense of *belonging* to a culture/community or emotional appeal is known as *pathos* in rhetoric. This particular case study is merely one example of many, to illustrate the ways in which digital heritage can be used as a rhetorical tool in community-university engagement.

Despite criticisms that digital heritage only benefits elitist/research universities, one cannot, and should not ignore its potentials as well. In relation to community-university engagement, this conversation is important because as scholars, it would be beneficial if the image of the university as the ivory tower is erased. University research and digital humanities should not be seen as elitist. Cultural heritage efforts can be inclusive and engaging. It does not have to be only for a select few such as anthropologist or historians. In short, in the task of preserving any form of dying art, digital heritage offers the possibility of *doing* research, pedagogy, and community-university engagement in innovative ways. It is worth exploring further to suggest more ways to make it both tangibly and intellectually accessible, for academics and the public alike. Last but not least, the humanities offer great intellectual resources for our students. Unfortunately, with universities being more driven by corporate and profit objectives, the existence of this area of scholarship is threatened. Digital heritage offers an avenue to keep the humanities alive. Perhaps the greatest benefit of humanities is learning to appreciate and differentiate between what is meaningful and what is not. What is the purpose of a university if it does not contribute to a community to make people's lives more meaningful?

Author's Note:

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UNLOCKING THE POTENTIAL OF RURAL GRASSROOTS INNOVATIONS: A POLICY BRIEF

Mini Hydroelectric Dam for Rural Electrification

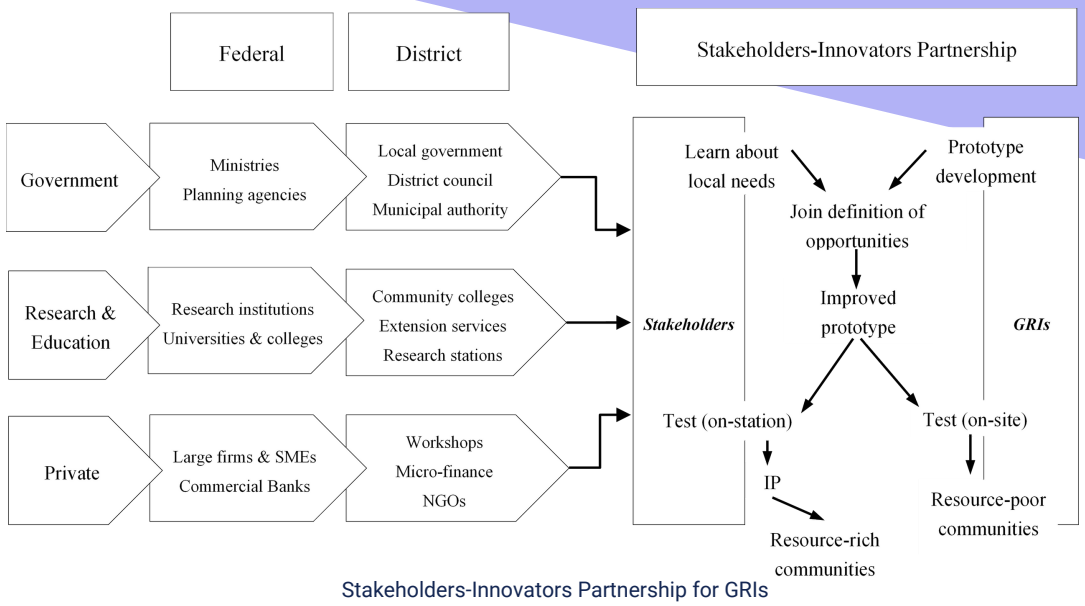
According to Anil Gupta, the founder of Honey Bee Network, Grassroots Innovations (GRIs) among the rural communities refer to a symbiotic network of like-minded individuals, innovators, scholars, academicians, policymakers, entrepreneurs and non-governmental organisations that acknowledge the local traditional knowledge holders. This localised network produces incremental innovations in tackling the local problems, which is different from the business innovations paradigms and mainstream research and development. While the grassroots are considered resource-poor in terms of monetary, working tools, and lobbying power, it is important to take note that they are rich and capable of sourcing local and creative works. As such, the socio-technical elements that motivate GRIs development need to be fully understood in the formulation of policies.

The Eleventh Malaysia Plan (2016–2020) that adopt a development path toward a 'humanisation-age economy'. The Malaysian Social Enterprise Blueprint (2015-2018) which is launched by Malaysian Global Innovation and Creativity Centre (MaGIC) is a targeted development plan closely related to GRIs movements. Among the strategic thrusts of the blueprint is one that aims to create awareness among the grassroots community while equipping them with the knowledge and skills necessary for success. Yayasan Inovasi Malaysia (YIM) was established in 2008 to organise and implement specific programmes to promote and inculcate innovation at the grassroots level. In 2006, YIM launched its Mainstreaming Grassroots Innovation (MaGRIs) project that focuses on upscaling and accelerating the development and diffusion of GRIs in Malaysia. Below are four successful GRIs stories that have been identified and supported under the YIM's Scouting for Grassroots Innovation programme:

i) Grass-cutting Machine for Pineapple Farming – A retired soldier and now pineapple farmer from a small village who innovated a simple grass-cutter that enables faster cutting of grass weeds without damaging the fruit of pineapple farms;

ii) Multipurpose Truck for Oil Palm Plantations – A small-scale oil palm farmer who invented an efficient and energy-saving transporter by using scrap metals to improve transportation of oil palm harvest;

iii) Mini Hydroelectric Dam for Rural



Stakeholders-Innovators Partnership for GRIs

Electrification – A villager who invented a mini hydroelectric dam to provide cheaper electricity supply for his local village;

iv) Paddy-Dispensing Machine for Paddy Plantations – A welder and later a paddy farmer who invented a paddy dispensing machine made from scrap metals and spare parts from unused vehicles.

In-depth interviews with the four GRIs have informed us of several policy concerns, among others:

i) Absence of policy instruments that provide supports at the initial stage of GRIs due to difficult for the government to identify an entry point to the geo-cultural embedded nature of this stage;

ii) Little interest among the grassroots innovators on IP programmes that are promoted by the public agencies.

The following policy recommendations are suggested to unlock the potential of rural GRIs:

i) Policy design should take a participatory approach and a mission-oriented policy approach is most preferable. This ensures the needs and aspirations of the GRIs are well taken into account to prolong their interest and aspiration to contribute to society.

ii) Reconsider the use of patents (or petty patent) as a means to measure the economic and social impacts of GRIs. Alternatively, recognition in terms of common knowledge freely shared practices, activist guidebooks and media seemed to be more appropriate in measuring the GRIs outcomes.

iii) Policy interventions should be oriented towards the safety issues of the innovation process and the inventions as most of the inventions from the grassroots rely on used parts and components.

iv) The government should act as a facilitator rather than get involved directly in the innovation process; it should not undermine and jeopardise the typical spirit and main interest of the innovators.

To conclude, the motives and rationales of public interventions in GRIs should be defined clearly to avoid oversimplified approaches that attempt to generalise and promote one-size-fits-all policies. It is a well-known fact that the current economic contributions of GRIs are less significant, but as part of the national inclusive development agenda, policymakers should understand and appreciate GRIs' contributions. Policymaking should appreciate the indigeneity of grassroots knowledge and avoid seeing GRIs as a profit-making agent. Enough room should be given for such local wisdom to flourish.

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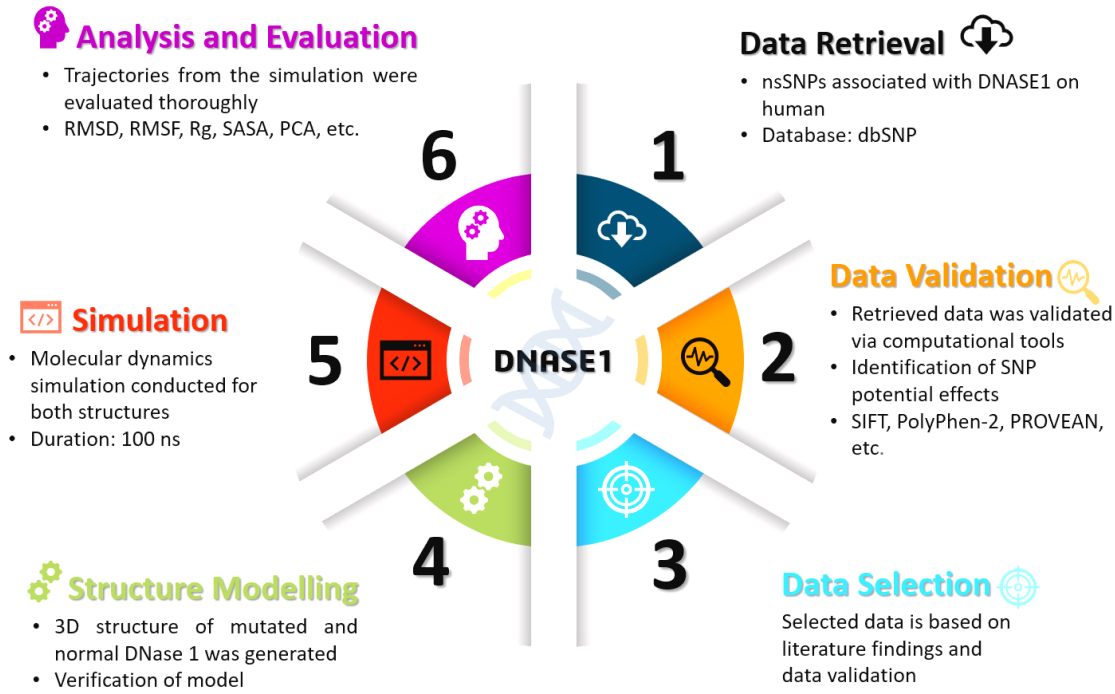
INSIGHT ON NONSYNONYMOUS SINGLE NUCLEOTIDE POLYMORPHISM IN DNASE1 THROUGH *IN SILICO* STUDIES



Overview of the in silico workflow.

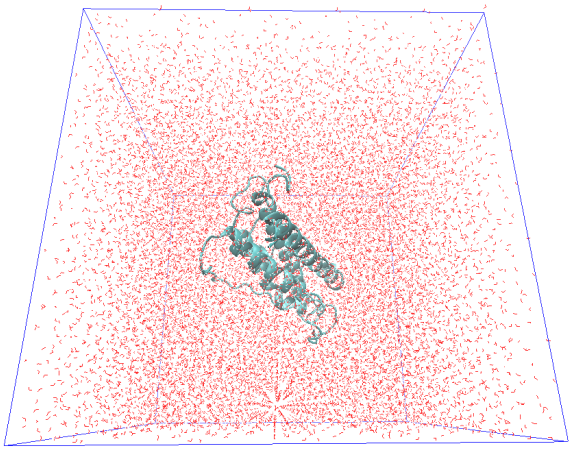
Information regarding three-dimensional (3D) structure and dynamics are essential to appreciate how biomolecules such as proteins work and function in its natural environment. Molecular dynamics (MD) simulation is an *in silico* method to simulate the motion of protein 3D structure in a defined condition that is impossible to visualise with a naked eye. It captures the behaviour of biomolecules at the atomic level and provides valuable insights to decipher biological function, mechanism of action, as well as uncovering the structural basis of a protein that associate with diseases. On the other hand, single nucleotide polymorphisms (SNPs) is a type of genetic variation that occurs at a specific location in the genome. Some of the SNPs can cause disease by changing the amino acid coded by the gene. These SNPs are known as nonsynonymous SNPs (nsSNPs).

Once a cell is considered damaged or dangerous to other cells, the cell is programmed to undergo programmed cell death, also known as apoptosis. The process of apoptosis involved several enzymes with one of them being deoxyribonuclease 1 (DNase 1), an endonuclease coded by *DNASE1* gene. DNase 1 plays a pivotal role in the degradation of chromatin, ensuring DNA clearance in human cells. In the absence or low activity of DNase 1, presence of the supposedly degraded DNA will stimulate aberrant immune response and specific antibodies. These antibodies tend to fight and kill our normal healthy cells and this reaction will lead to autoimmune diseases such as systemic lupus erythematosus (SLE) and psoriasis which can be fatal if not treated. Although many studies have identified nsSNPs on *DNASE1* gene, the effect of this mutation on the latter cellular processes or its relation to

autoimmune diseases is still poorly understood.

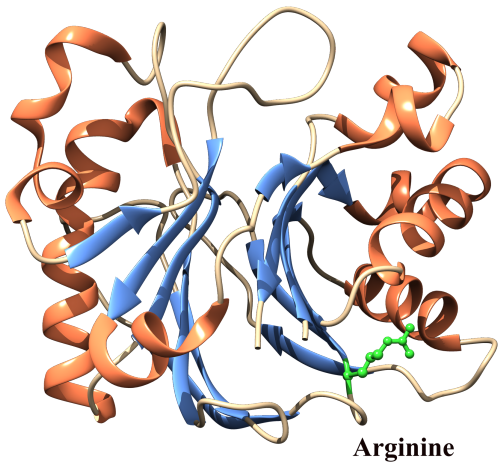
This study was conducted to understand the impact of a single point mutation, particularly nsSNP found on DNASE1 gene towards the corresponding protein structure (DNase 1). The general in silico workflow is visualised in Figure 1. Generally, based on the deposited nsSNPs related to human DNASE1 in a public database, several computational tools were utilised to filter and identify a potential nsSNP that could result in DNase 1 malfunction. The implication of this nsSNP towards the structural basis of DNase 1 was evaluated through protein structural modelling and MD simulation. Interestingly, the simulation has revealed that the mutated DNase 1 structure shown to possess greater flexibility and appeared to be more 'exposed' compared to the typical DNase 1 structure. These implied that the mutated structure is unstable in the natural environment and unable to function optimally as a protein. Therefore, the identified mutation or nsSNP on DNASE1 gene, has indeed caused a damaging effect towards the DNase 1 protein structure, which in turn, reduce its functionality.

Overall, this study able to shed some light into how genetic variant can affect the functionality of a protein through a computational approach. Moreover, identification of the causative nsSNP may open to new possibilities and ideas into novel treatment strategies in the future. Last but not least, this study also highlighted the power of computational tools that can strengthen current knowledge and research in science.

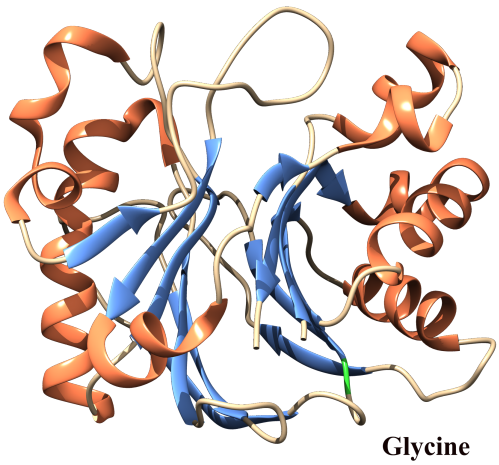


Molecular Dynamics Simulation

(A) Normal DNase 1 structure



(B) Mutated DNase 1 structure



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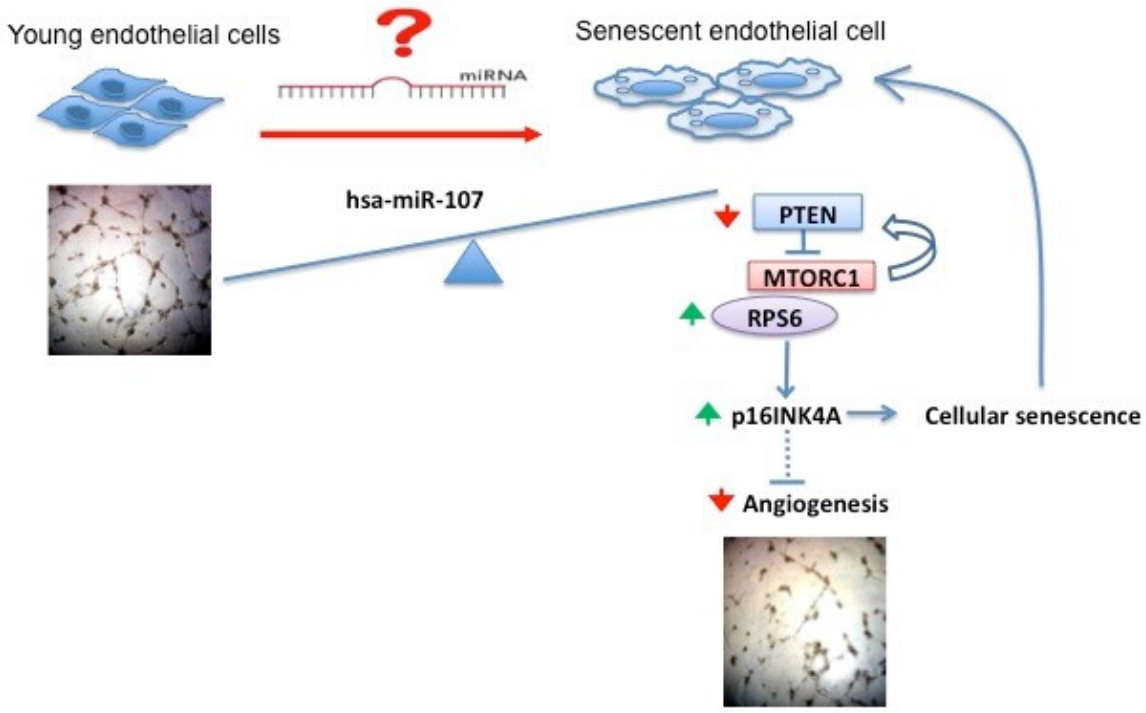
TARGETING AGING AT THE CORE: MICRORNAS IN CELLULAR SENESCENCE



Cellular senescence can be defined as the biological aging of the cell where the cell's functionality gradually deteriorates. Senescent cells are unable to divide and proliferate but remain metabolically active. Without the ability to divide, prolonged continuous mass growth leads to a state of increased size. These cells can also acquire the secretory phenotype, termed as SASP can to secrete soluble mediators that affect surrounding healthy cells in the tissue microenvironment. Senescent cells can be detected by markers such as increased expression of senescence-associated-beta-galactosidase (SA-b-gal) and p16INK4a.

Cellular senescence and aging

Since cells are the basic building blocks of living organisms, it is thought that cellular senescence contributes to organismal aging. Indeed, extensive research has shown that senescent cells accumulate in aging and diseased tissue. Accumulation of senescent cells affects tissue regeneration, causes tissue dysfunction and chronic inflammation which drive premature aging process leading to increased risk of developing cancer and cardiovascular diseases.

MicroRNAs and cellular senescence

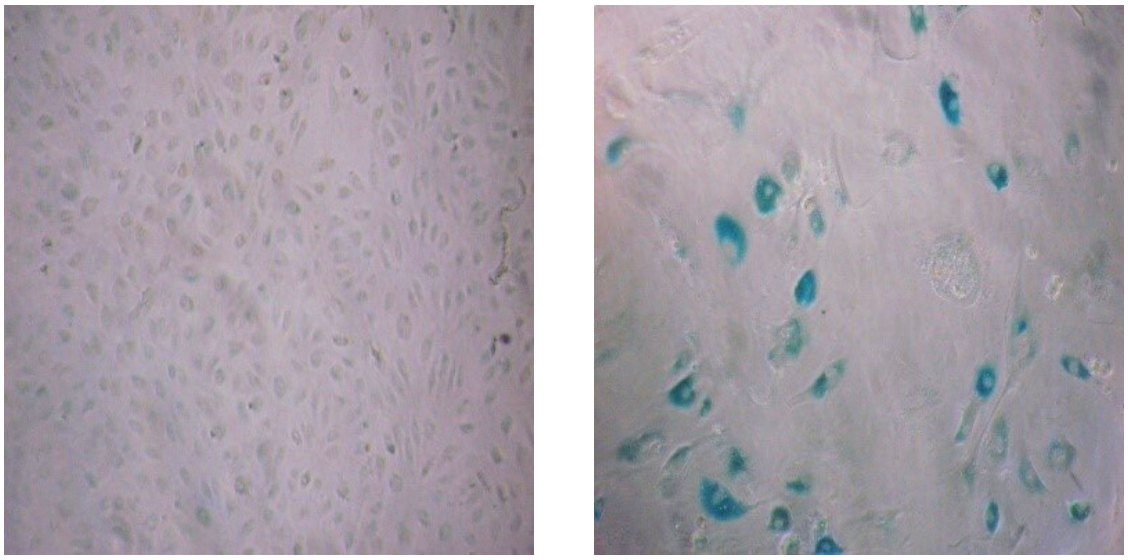
MicroRNAs (miRNAs) are highly conserved small non-coding RNAs of 18-25 nucleotides in length. They are endogenously derived from the host genome and are responsible for regulating gene expression, mostly by down-regulating the expression of their target genes. MiRNAs are instrumental in controlling cell signaling pathways that regulate various biological functions including cellular senescence. One well known example of miRNA in cell cycle regulation is miR-34a, which suppresses SIRT1, a longevity gene, resulting in premature senescence and apoptosis.

Targeting aging at the cellular level

At the cellular level, life span can be prolonged by the inhibition of mammalian target of rapamycin complex 1 (MTORC1) pathway. MTORC1 responds to inducers such as growth factors, nutrients and energy in regulating cell growth, survival and metabolism. Our study revealed that the inhibition of MTORC1 pathway can delay the onset of endothelial cell deterioration. Endothelial cells are cells that line the interior surface of blood vessels. Accumulation of senescent endothelial cells can cause endothelium dysfunction and leads to the development of cardiovascular diseases.

The specific miRNA which is involved in the inhibition of this pathway is identified as miR-107. miR-107 targets phosphatase and tensin homolog (PTEN), which functions as a tumor suppressor. The increase in miR-107 expression leads to a fall in PTEN levels and the rise of MTORC1 activities which prompt cell senescence and inhibit the ability of endothelial cells to form blood vessel-like tube in vitro. On the other hand, the decrease of miR-107 via long-term low dose treatment with rapamycin, a drug that targets MTOR, delays senescence.

By understanding the mechanism of endothelial senescence, identification of new therapeutic targets and the development of RNA-based therapies for cardiovascular disease intervention will be made possible. This is especially beneficial as age-related diseases are on the rise alongside the increasing numbers of aging population all over the world due to medical and technological advancement. Thus, through further applied and translational studies, this discovery could benefit global aging population by reducing risks of aging-related diseases.



SA-ß-gal staining of young (left) and senescent (right) cells.
Cells expressing SA-b-gal activity at pH 6.0 are stained positively in dark blue.

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CANOPY-LEVEL URBAN HEAT ISLAND EFFECT IN GREATER KUALA LUMPUR

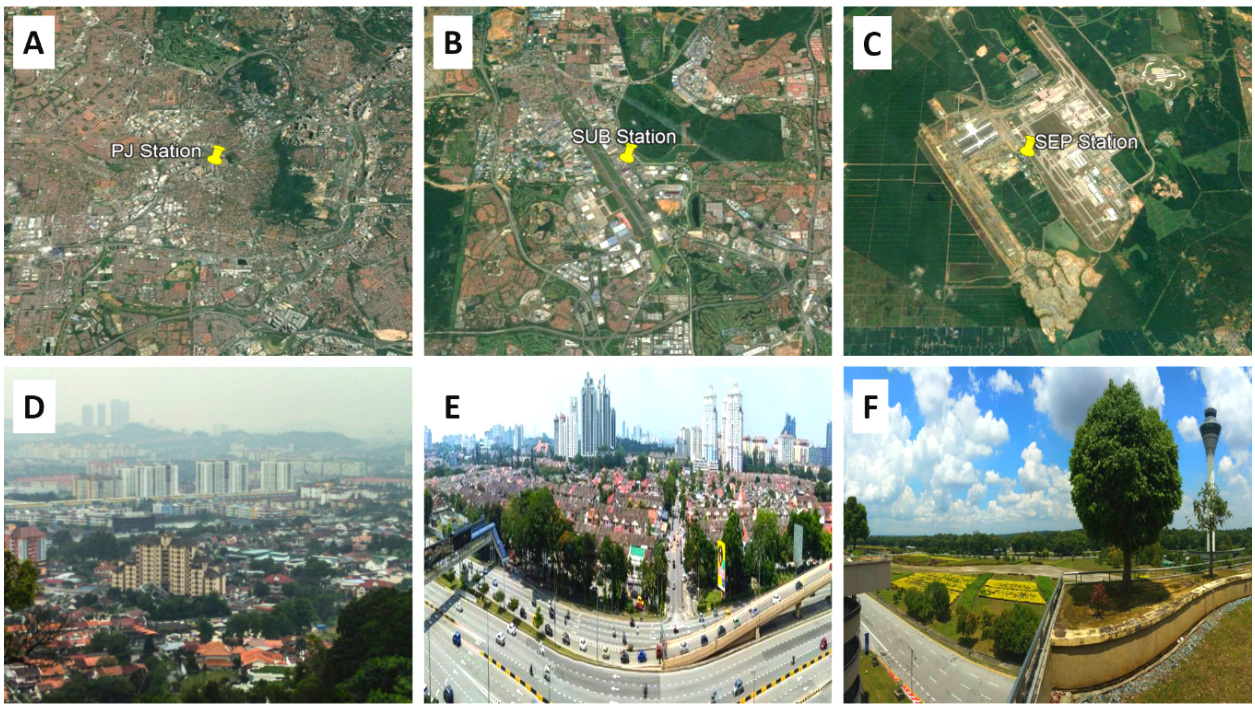

Fig. 1: Study sites: (A & D) PJ station; (B & E) SUB station; (C & F) SEP station

Similar to many south-east Asian megacities, Greater Kuala Lumpur (GKL) suffered inevitable territorial urban development while hosting one-fifth of the current urban population of Malaysia. Being a dynamic geopolitical region in the heart of south-east Asia, GKL is envisaged to spur the country's economic growth by leveraging upon its strengths on a cosmopolitan population and world-class infrastructure as espoused in Malaysian Tenth Plan. Due to a notable role as addressed in Malaysian policies, GKL and the other townships within the conurbation observed an overwhelming economic and human capital development which has led to a surge in population density and urban growth footprints. As a result, high population growth mandates the satellite towns in the conurbation to expand both vertically and horizontally while imposing a greater impact on local urban climate often manifested in the form of Urban Heat Island (UHI). UHI, an ephemeral phenomenon where the cities are relatively warmer than the surroundings creates a substantial need for cooling the main city centres in GKL.

Realizing such need, a program was initiated to study the multifaceted dimensions of UHI using case study approaches. In one of such case studies, the temporal variations of canopy-level UHI in selected urban stations, namely Petaling Jaya (PJ) and Subang (SUB) (Fig. 1), was evaluated using 2016's hourly data set obtained from meteorological observatories. Meanwhile, Sepang (SEP) station was considered as a sub-urban reference station in this study.

At the same time, the association between meteorological factors and UHI Intensity (UHII) was evaluated using linear regression models and Pearson correlation analysis. The findings revealed positive thermal contrasts between urban and sub-urban stations with maximum UHII during dry, southwest monsoon season in PJ (June: 1.68 ^{0}C) and SUB (August: 1.29 ^{0}C) stations respectively. PJ station exhibited a distinct diurnal cycle with the maximum nocturnal UHII of 1.71 ^{0}C at about 8 p.m. after sunset under ideal meteorological conditions.

The results also demonstrated that UHI events occurred more frequently at nights in urban stations in the magnitude range of 0–2 ^{0}C. Cooling at all urban sites starts around 2–3 p.m. with the highest rate of 0.73 ^{0}C/h and 0.96 ^{0}C/h in PJ and SUB stations. Meanwhile, relative humidity displayed a low positive correlation ($r = 0.37$, $p \geq 0.05$) and a high negative correlation ($r = -0.79$, $p < 0.05$) with UHII in PJ and SUB stations respectively. The influence of wind speed on UHII is weak ($r = -0.44$, $p < 0.05$) in PJ station and strong ($r = 0.83$, $p < 0.05$) in SUB station.

In brief, this study was a primary attempt to evaluate temporal variations of canopy-level UHII over seasonal and diurnal scales in the selected urban stations of GKL which provides vital inputs to enrich the tropical urban climate literacy. The acquired knowledge of the UHI issue and related underlying mechanisms is expected to assist urban planners, designers and decision makers to perform more evidence-based decision making to create, reform or rejuvenate climate-friendly sustainable cities for enhanced liveability in future.

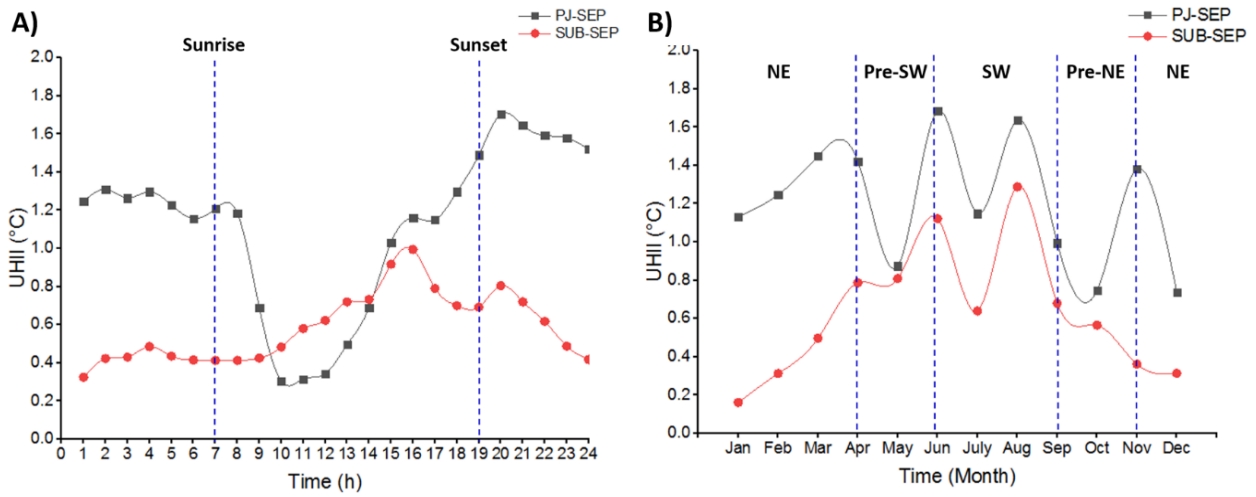

Fig. 2: Temporal variations of UHII: A) Diurnal variations; B) Seasonal variations

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